White Paper on the CISE BPC Plan Pilot (3/3/2019)

This document is the result of contributions from a number of members of the community supported by the National Science Foundation's (NSF) Directorate for Computer and Information Science and Engineering (CISE) with experience and expertise in Broadening Participation in Computing (BPC). These individuals participated in the writing or reviewing of this document, and/or served on the "BPC panels" that reviewed over 350 BPC plans submitted as part of CISE's Large and Medium core programs research proposals in the Fall of 2018. To protect the confidentiality of the review process, the names of these individuals are not being disclosed. Further, every effort has been made to protect the confidentiality of the review process for the proposals described above. Moving forward, the authors of this white paper will simply be referred to as such—"the authors of this white paper."

At the end of the review panels, the panelists were asked about their overall impressions of the BPC plans. Their comments are listed verbatim in Appendix A. They found many (most) of the BPC plans to be of poor quality, not likely to have a significant impact on inclusion. That means it is incumbent on NSF to provide appropriate resources and to further inform our community [including prospective principal investigators (PIs), members of our review panels, and program officers] about creating and evaluating effective BPC efforts. This document was assembled to assist in that task.

Introduction. Computing is an increasingly indispensable part of modern life, yet large segments of our population remain underrepresented in academic computing departments and in the computing and computing-enabled or computing-related professions. Women, African Americans, Hispanics, Native Americans and Indigenous People, and persons with disabilities all participate in computing at very low rates, and other groups—such as those from rural areas, or of poverty or immigrant status—may also have limited opportunities to participate. This underrepresentation deprives individuals of access to lucrative, creative careers and pursuits, but it also deprives our nation of much-needed talents and ingenuity. All segments of society deserve the opportunity to participate in shaping the information technology affecting so much of our lives, and the contributions of all segments of society will be needed if we are to maintain our global leadership in IT innovation.

NSF includes broadening participation in its core values, as it seeks and accommodates "contributions from all sources, especially … groups that have been underrepresented.[1]" In keeping with those cores values, the CISE directorate has long supported effective BPC programs. Progress, however, has been slow.

Further progress to increase representation will require an increase in the range of interventions to achieve cultural change across colleges, departments, classes, and research groups. It will also require an increase in the intentional, active engagement by members of the CISE research community.

> *What if every PI or Co-PI, along with their graduate and undergraduate students, was actively engaged in meaningful, and impactful, BPC activities? Not only would our university and college departments be more inclusive, but each year, a wave of graduating students would enter the workforce holding inclusion as a core value.*

CISE aims to partner in facilitating cultural shifts of the academic computing community by requiring that PIs incorporate BPC plans in select CISE-funded projects (Medium and Large-class projects in the CISE core programs and similar-sized projects in the Cyber-Physical Systems as well as Secure and Trustworthy Cyberspace programs). A range of activities will be acceptable, and PIs should choose activities based on their own level of BPC experience, as well as the contexts of their institutions, departments, and research groups. They are encouraged to think of the impacts of their activities both in terms of who is served (number of people) and how they are served (quality and intensity of interventions):
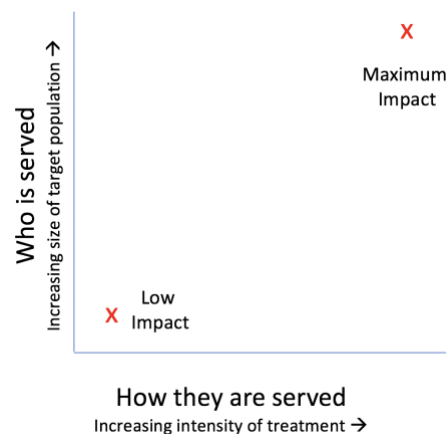
Contributions can be made throughout this space. Sustained investment is best, rather than a single "dose" event like a roadshow or lab tour, though the shorter activities may serve to initiate or catalyze movement in a specific direction.

One way to ensure a sustained engagement and more significant impact is for PIs to consider activities that are part of plans used in departments for quality and continuous improvement such as strategic initiatives or broadening participation efforts, or part of campus-wide outreach. Individual activities are possible but efforts to mitigate causes of underrepresentation will have

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[1] *Broadening Participation at the National Science Foundation: A Framework for Action*, August 2008.

the most impact if PIs collaborate for *collective impact*.[2] PIs could, for example, work within departmental plans or they could join existing, successful programs with a BPC focus at the national or regional level.

The NSF-funded BPCnet.org portal provides resources, support, and guidance to assist PIs in developing and implementing effective BPC activities and plans, departmental plans, and connections to a range of existing BPC-focused programs at the national level. These resources are not meant to be exhaustive, and it is important to consider the current climates and ecosystems in which BPC plans will be implemented.

The purpose of this document is to provide clarifications on an ideal BPC plan, guidelines for creating departmental plans, and guidelines for PIs in preparing their own meaningful and impactful plans.

Elements of a BPC Plan. The ideal BPC plan is well-developed, impactful, and cohesive, describing an evidence-based, sustained response to a well-articulated aspect of broadening participation. However, that is a very high bar and it is recognized that many CISE PIs, especially those new to BPC, will not initially be in a position to develop or execute such an ideal plan. Every effort should be made, however, to articulate a plan in which the actions and impacts are clear and compelling. Over time, we expect that the CISE community will build its capacity for BPC and, given that goal, plans can focus on *developing BPC capacity* for PIs and their departments. To assist in that development, this document describes rubrics and developmental progressions that can be used to
improve BPC activities and readiness.

The activities of the BPC plan do not have to relate to the research described in the full proposal. Nor do they have to be novel: instead, PIs might cite and leverage well-documented, proven strategies to broaden participation at the national, regional, or institutional levels. Likewise, academic computing departments or schools may use this opportunity to create their own, collective plans to leverage local expertise and institution-wide efforts in providing opportunities for PIs to participate in BPC activities. Guidelines for crafting a departmental plan are given in Appendix B.

All PIs and Co-PIs submitting a proposal should be involved in specified roles in the activities described in the plan. The involvement of graduate students—and possibly even undergraduates—in the effort is encouraged. Activities may be collaborative, across multiple campuses, or they may be individualized to home institutions.

In the Fall of 2018, inputs from expert reviewers were used to develop a rubric for BPC Plans across four categories: Context, Strategy, Target, and Measurement and Dissemination.

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[2] For additional information on collective impact see
https://www.nsf.gov/od/broadeningparticipation/INCLUDES_report_v16_WEB.pdf

CONTEXT describes the **problem or need** to be addressed, how the proposed approach aligns to the capacity and mission of the PIs (i.e., the **rationale**), and the **goals** of the effort. It demonstrates an awareness of the underlying issues of underrepresentation (noting that raising such awareness can be an acceptable goal).

Problem/Need: PIs should provide data or other evidence that situates the proposed effort. For example, if the proposed work incudes recruiting underrepresented students into a department Research Experiences for Undergraduates (REU) program, it would be important to provide the relevant demographics of the university, department, and participants in any current REUs. As another example, proposals that include professional development for K-12 computer science (CS) teachers should provide data on access to CS courses at the state and local school district levels.

Rationale: The proposal should explain how the BPC plan aligns to the capacity and mission of the PI(s) or their department's overall BPC plan. Note that the chosen activities do not have to be related to the research described elsewhere in the proposal, but in cases where it is, that alignment should be described as well.

Goals: The proposal should succinctly describe the measurable goals of the BPC plan. Goals should be measurable over a specific time period. Some examples include:

- The BPC plan will include 10 African American students in a year-long software design and robotics program.
- Over the award period, five graduate students will receive training in Universal Design for Learning, as well as how to work with students with autism.
- The faculty hiring process will be revised to include promising practices for recruiting, interviewing, and hiring faculty from diverse backgrounds.

STRATEGY identifies the approaches that build on the stated goals, consisting of **activities** to be undertaken by the PIs, research team, and their collaborators, along with the **resources** that are needed to ensure that the project is viable—all of which are built around the needs and strengths of the **target** audience.

Activities: If PIs have past or existing BPC efforts with successful interventions, they do not need to create an innovative or new effort. However, they will need to provide evidence of the PIs' commitment and engagement with the plan plus evidence that those efforts will continue through the life of a funded project.

Leveraging other successful and evidence-based activities through collaboration or partnerships is highly recommended. For example:

- A team of PIs wants to develop a week-long summer immersion program for African American boys living in an urban center, but they have never taught in a summer program or developed a curriculum for high school students. Developing a partnership with a well-known, national organization that teaches young men of color to code would allow the PIs to leverage the partner organization's expertise in youth

development, while engaging the program experts in developing appropriate materials for a week-long program.

It is a good idea to engage members of the identified, targeted communities in as many aspects of the plan and its development as possible.

Resources: All plans should show evidence of adequate resources, including fiscal, human, department, community, or national partnerships, and use of documented best or promising practices.

The authors of this white paper also recommend that BPC plans have a **BPC Prior Work** section. Eventually, such a section should list the BPC outcomes of any awards that were funded with the BPC requirement. In addition, any of the PIs' past BPC work (funded by NSF or not) that is related to the current BPC plan, should be described. Such a section would also benefit PIs who are already active in BPC—not everyone needs to do more! *PIs who have prior BPC activities, with proven successes, can continue those activities during the lifetime of a new award, and include them in their BPC plans.* In these cases, a PI should describe the efforts that are to be undertaken as part of this current proposal, and they should explain how the results of prior work contributed to any change or growth reflected in the current plan.

TARGET specifies the intended population and provides clear demographic data on that population. It should include the number of educators or students involved in the effort. For example:

- Our monthly hackathon will regularly include 20 tenth-grade girls, of whom at least 50% will be students of color.

MEASUREMENT/DISSEMINATION helps to define the impact of the work. BPC plans should include a plan for meaningful assessment to measure progress toward the PIs' stated BPC goals. The assessment plan should identify an appropriate approach that ties to evaluation and identified metrics and/or instruments for assessment. Assessment may include collecting quantitative data (e.g., numbers and self-reported demographics of students from underrepresented groups in application pools before and after implementing a recruitment strategy) and/or qualitative data (e.g., interviewing participants about their attitudes and perceptions about computing after participation in a proposed after-school program). The ideal plan would have a system for using the results from the data in an iterative process to strengthen the efforts over time. The scale of the assessment and evaluation plan will correspond to the scale of the BPC effort.

BPC plans should include a thoughtful strategy for sharing results of the implementation to allow others to learn about effective new models and strategies for adaptation of evidence-based approaches. To the extent possible, relevant communities should be fully informed of the results of the work and its role in BPC. For example, a partnership that works with girls from a local chapter of a national organization and results in an increase in the number of young women of color involved in computational thinking activities could report such outcomes to the national

organization, as well as to the local community (including parents and teachers), the department supporting the activities of the BPC plan, and the CISE community.

The complete rubric developed by the authors of this white paper is given in Appendix C. Like most rubrics, it reads like a scoring document and, in the case of this BPC effort, is aspirational—few submitted plans scored at the highest level. The BPC plan reviewers were concerned that the rubric might be intimidating, particularly to those new to BPC efforts. That is not the intention of this document; instead, we see the document as offering guidelines to progress—helping PIs to develop plans that are meaningful in the context of their individual experiences and their local environments. With that in mind, the authors of this white paper developed a second view of the rubric which aligns with the original rubric but highlights the progressions that a PI can go through in developing their BPC expertise and impacts over time (Figure 1). Reviewers are looking for progress, not perfection, in evaluating individual BPC plans.
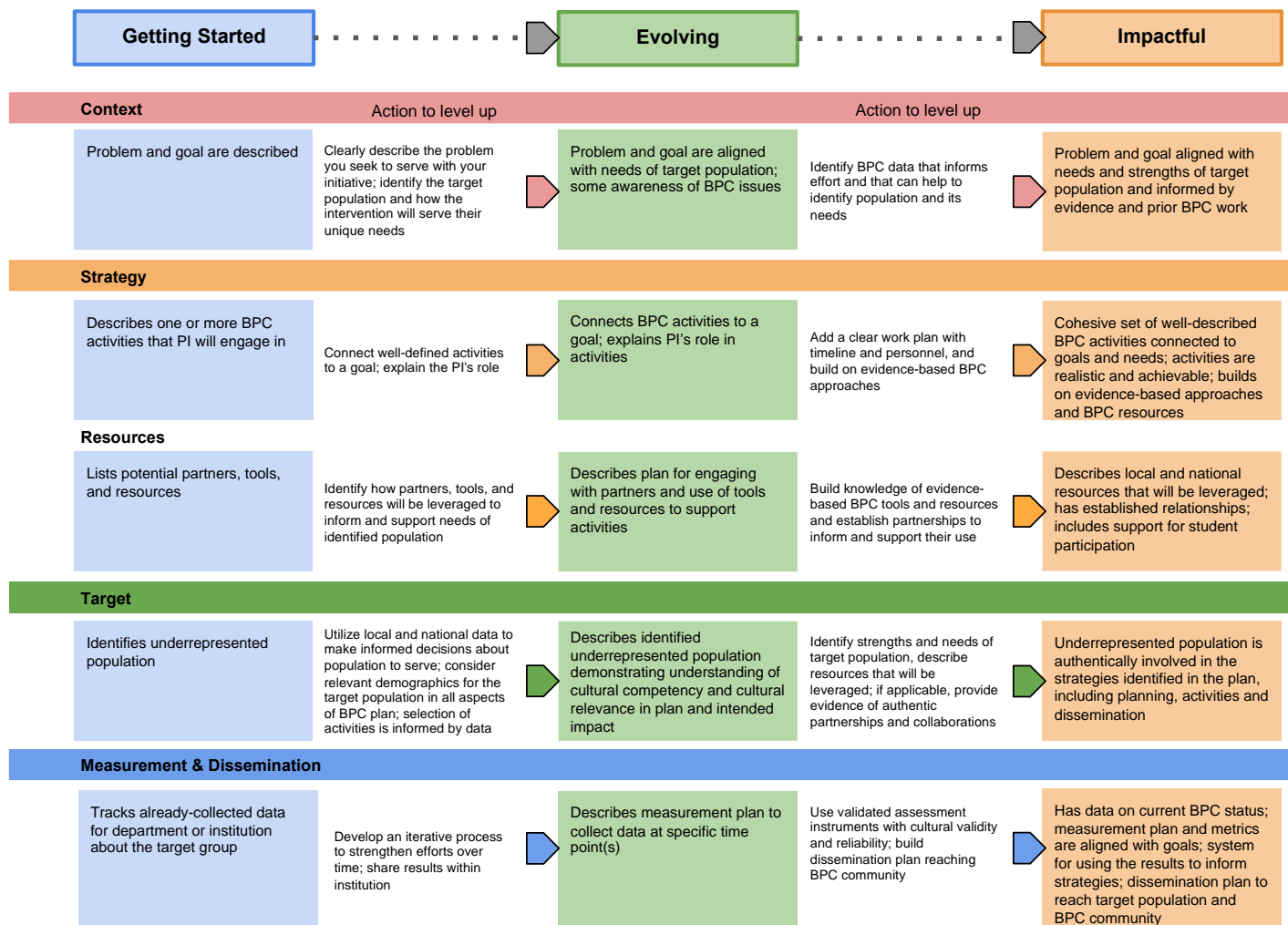
Figure 1. Developmental view of the BPC Rubric

Finally, based on the BPC plans submitted in the Fall of 2018, the authors of this white paper also constructed a list of Do's and Don't's aligned to the five rubric elements.

	DO	DON'T
CONTEXT	Provide evidence supporting the need for the BPC activities that you are describing	Propose activities without regard to what need they are addressing
		Provide no evidence that the group you are addressing is underrepresented in computing
		Address too broad a group, for example, "all" underrepresented students, without specific details on the needs of the included populations and how they are addressed in the proposed work
	Provide detail about the relevant context of your targeted effort, either national, local, or both	Omit a target or goal for your BPC activities
		Propose K-12 outreach without details[3]
		Assume "if you build it, they will come," i.e., the idea that really cool research alone will attract underrepresented students
	Provide a cohesive BPC plan with well-defined actions aligned to identified need	Provide a laundry list of unrelated BPC activities ("spaghetti on the wall")
		Assume that your own membership in an underrepresented group, or your role as a faculty member at a Minority-Serving Institution, is sufficient
		Assume that your prior work alone is sufficient
	Describe any prior work that informs the current BPC plan	List PIs or students from underrepresented groups as evidence of BPC without tying them to specific recruitment strategies or activities going forward
STRATEGY	Clearly state the intended impact or goal(s) of your BPC plan and identify activities or strategies within the context of that (those) goal(s) that reflect best practice(s)	List activities without the context of a goal; fail to identify best, or promising, practice(s) in the identified area
		Omit references/citations
	Provide a reasonable scope of activities given the experience and bandwidth of the PIs, institutions, partners, and resources available	Overpromise or fail to define the scope
	Provide a clear workplan, including personnel and their roles	Omit a timeline or a division of responsibilities among PIs and Co-PIs

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[3] For plans that include K-12 outreach components, PIs should keep in mind that planning and executing out-of-school programs and summer camps is not trivial, and if done without appropriate training, context, and planning, can do more harm than good in terms of how participants experience computing. Leaders of outreach programs should demonstrate that they are knowledgeable about the target group (e.g., age, ability), as well as implicit bias, stereotype threat, and, more broadly, inclusive pedagogy; PIs planning outreach activities may consider participating in relevant training in the first year of the plan. In addition, PIs should have channels and strategies for recruiting students, and their programs should build on best practices or existing resources for inclusive, engaging experiences.

	DO	DON'T
RESOURCES	Provide a clear plan to form partnerships as appropriate, either locally or through BPCNet.org, or describe bona fide existing partnerships	Omit partners, if present, or a plan to form partnerships, if required
		Omit letters of collaboration
	Include local resources or national BPC organizations in an advisory or partnership role	Create a project on your own without adequate background or consideration of best practices
	Form alliances with BPC organizations and provide resources to support students or faculty in BPC organizations	Fail to identify BPC organizations or resources that can help support students covered by your plan
		Rely on "long history" or "long track record" or "we will leverage" without offering details
		List organizations, saying we will "engage" or "participate" or "support," but with no specifics
TARGET	Acknowledge intersectionality whenever possible or appropriate[4]	Rehash Broader Impact without authentically addressing BPC[5]
	Create a plan that is culturally relevant for an identified underrepresented group and genuinely broadens their participation in computing	Identify a group that does not meet the NSF criteria for underrepresented groups, or consider any broadening of participation to be BPC regardless of participants
	Include evidence that the targeted group will be reached	Neglect to actually talk to partners (including K-12 schools) before developing and submitting a plan
	Demonstrate needs of underrepresented groups, and show evidence of cultural competency and cultural relevancy of plan; build on strengths of the community to be served	Use a deficiency lens (i.e., a particular group needs easier classes)
MEASUREMENT & DISSEMINATION	Clearly articulate cohesive objectives, activities, and metrics to evaluate success	Omit metrics aligned to goals and objectives
	Rigorous measurement plan that relies on validated instruments when possible	Omit a measurement plan
		Rely solely on counting as the metric
	Include a plan to disseminate BPC work, and identify potential outlets	Omit a dissemination plan or provide a plan that does not share findings with the larger BPC community
	Identify ways in which evaluation findings will be used to iterate on BPC activities	Ignore findings or fail to include a mechanism for incorporating formative evaluation findings
	Involve expertise in BPC when appropriate	Describe BPC activities developed without any BPC expertise

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[4] The overlap of various social identities, such as race, gender, sexuality, and class, as they contribute to the systemic discrimination experienced by an individual.

[5] The authors of this white paper commented on a common misunderstanding, noting that Broader Impacts are not the same as broadening participation. As an example, teaching cybersecurity to all fifth-graders in a district might well be a broader impact; however, without attention to inclusivity and equity, it might not achieve any broadening of participation.

APPENDIX A: Verbatim comments from the review of the Fall 2018 BPC Plans

These comments from experts in Broadening Participation—on the *collective set/pool* of BPC plans in Fall 2018, as opposed to any individual plan—are included here simply to illustrate the importance of educating the community about how to approach this subject. It is recognized that change will not happen overnight; sustained effort will be required.

- *Very few were strong. Some were incredibly uninformed (tokenism, deficit perspective, etc.).*
- *Low quality. We were struck (but not surprised) by the lack of awareness of basic definitions and research-based approaches.*
- *While many of the BPC plans exhibit the potential to produce great work ... there [were many] that were not explicit about what groups were to be targeted.*
- *Overall, they all seemed to be missing major components. There was a wide variety of projects, some that noted very little involvement and others that seemed very big and infeasible.*
- *Overall most of the plans lacked concrete steps and had no plan for evaluation.*
- *Middling to low quality in general, though we called the "middling" proposals "evolving" as they generally had a grain of a good idea.*
- *There were few strong plans (5-10 max out of 70).*
- *Most BPC plans were not high quality. It felt like PIs did not treat the creation of a BPC Plan as seriously as writing the Intellectual Merit portion of the proposal.*
- *I only saw one proposal that has all of the characteristics that I was looking for (mentoring, recruiting, retaining, outreach, training, assessment and evaluation).*
- *Overall, the plans were a good start with room for improvement.*
- *Overall, the plans need a lot of work. It's clear that the PIs are not very experienced in BPC.*
- *Overall, the plans were not really coherent plans, but a listing of past efforts or diversity-focused programs at the PIs' institutions. I'd expected the PIs to "make the connection" and explain why they may be choosing to continue efforts (outcome/impact) or how BP programs would be leveraged. Many were lacking critical details.*
- *There were a range of plans—some more detailed and written as actual plans and others were a list of activities.*

APPENDIX B: GUIDELINES FOR A DEPARTMENTAL BPC PLAN

The departmental BPC plan outlines a strategic vision for broadening participation of underrepresented groups in computing. Developing and implementing the departmental plan provides an opportunity to bring the faculty, students, and staff together for a collective mission that can drive significant institutional change.

The plan can be used by faculty within the department to support the development of their own BPC plan for submission as part of an NSF proposal. An effective departmental plan will make it easier for PIs to contribute to a larger, more impactful BPC effort. The departmental plan should be limited to 1-2 pages. PIs using the departmental BPC plan are expected to develop 1 additional page that details their own goals and activities and how they connect to the departmental plan.

Department Plan Components

1. **Context:** What is your context in terms of demographics (statewide, university, department)? Include local context (e.g., what are the nearby schools like?).

2. **BPC Mission:** Articulate the BPC mission. This is a big picture statement that describes the strategic vision for the department. Examples:
   o The mission of the Broadening Participation Plan of Mars University is to graduate a diverse group of majors who have a demographic makeup similar to that of our surrounding urban community, which is 40% African American and 20% Latinx.
   o The mission of the BPC Plan of the Dept of Information Sciences at University X is to increase the proportion of undergraduate women and students of color who major or minor in computing.
   o The mission of the BPC Plan of the CS Department of ABC College is to build computational agency in public school students in the JKL School District.

3. **Goals and activities:** Details departmental goals and activities that contribute to advancing the goals of the project plan. Goals may focus on systemic change or specific improvement in the recruitment, retention, or advancement of underrepresented populations, with focus on:
   o Faculty and staff (e.g., advising staff, instructional faculty, tenure-track faculty, research staff and faculty, administration);
   o Students (e.g., undergraduate or graduate, within or beyond your department);
   o Institution or Profession (e.g., college, university, professional organizations); and
   o Community (e.g., K-12 schools, community colleges, adult/continuing education, workforce training).
   Goals should be specific and measurable. Activities that contribute to the goal should build on evidence-based approaches for BPC, leverage existing resources, and build on or result in partnerships with organizations.

4. **Metrics for success:** Details departmental commitment to reviewing progress towards goals and fulfillment of mission. The departmental plan should identify an appropriate approach to evaluation and identify metrics and instruments that will be applied to measure how well the proposed activities advance the department toward an identified goal.

See also "Mary Hall, Richard Ladner, Diane Levitt, Manuel Pérez-Quiñones: Broadening Participation in Computing is Easier Than You Think," *CACM Blog*, https://cacm.acm.org/blogs/blog-cacm/233339-broadening-participation-in-computing-is-easier-than-you-think/fulltext.

APPENDIX C: BPC PLAN RUBRIC

The complete rubric developed by the authors of this white paper is given below. This rubric is aspirational, and can be potentially intimidating, particularly to those new to BPC efforts. The intention of this document is to offer guidelines to progress—helping PIs to gradually develop plans that are meaningful in the context of their individual experiences and their local environments.

Context		
Highly Developed *Potential for impact is high*	*Developed* *Evidence of potential impact*	*Undeveloped* *Potential for impact is low*
- Problem or need is clearly described with supporting evidence - Target issues are identified and placed in the context of appropriate, existing demographic data from, for example, national, university and departmental data sources - Goal(s) are appropriate to the needs and problems described - Goal(s) are clear, concrete and measurable - Description and results of any Prior Work on BPC that the PI/CoPIs may have done informs the current plan - The plan describes how the PIs and project team will respond to a specific need within the university or community	- Problem or need is described but without any supporting evidence - Awareness of national BPC issues but no relevance to local context (or vice versa) - Goal(s) listed are insufficiently aligned with needs and strengths of population to be served - Description and results of any Prior Work on BPC are not aligned to current plan or do not sufficiently support current plan	- No problem or need is described - Goal is not clear - List of experiences and engagement (both student and PIs) in prior activities with no clear connection to BPC strategies - Lists of students (names, demographics) with no correlation to BPC pathways, relevant BPC activities, or systemic BPC strategies
Strategy		
Highly Developed *Potential for impact is high*	*Developed* *Evidence of potential impact*	*Undeveloped* *Potential for impact is low*
- Strategies build on goals, consist of activities to be undertaken by the team, consider systemic change (e.g., department culture; recruitment processes), are described in detail, and are grounded in best practices for equity and inclusion	- Strategies or activities are lacking detail and overly generalized	- Listing activities without stating their role - Series of initiatives with no info about what impact will be achieved
Strategy cont…		

Highly Developed *Potential for impact is high*	Developed *Evidence of potential impact*	Undeveloped *Potential for impact is low*
- Strategy(ies) leverage past/existing BPC activities, departmental BPC plans, and campus, university and community efforts as appropriate - The scope is realistic given the project team's expertise and the available resources (time, funding, personnel, etc.) - Proposed activities are appropriate to the needs and strengths of the target populations - Work plan includes a timeline, personnel assignments and qualifications	- Strategy(ies) reference past/existing BPC activities, but show limited connection to departmental BPC plans, and campus, university and community efforts; no explanation of how PIs will interact, leverage or expand - Scope exceeds the project team's expertise and available resources(time, funding, personnel, etc.) - Description of strategies or activities without describing the target population, goals, or metrics for success - Proposed activities are not clearly aligned to the needs and strengths of the target populations as described in the proposal; description of strategies or activities without providing proof of concept (why they believe that is the right approach) - Description of strategies or activities without a demonstrated understanding of best practices - Incomplete work plan, timeline, personnel assignments and qualifications	- "Kitchen sink" approach: too many interventions for too many targeted populations to be plausible or coherent - No mention of past/existing BPC activities in their organization/ department/ community - Scope and amount of time that will be spent are unclear - No timeline or personnel assignments and qualifications

Target		
Highly Developed *Potential for impact is high*	*Developed* *Evidence of potential impact*	*Undeveloped* *Potential for impact is low*
- Acknowledges intersectionality - Provides relevant demographics of the target community and/or participants - Demonstrates an understanding of target population with respect to cultural relevance of BPC plan - Provides evidence of cultural competency through description of project(s) to be undertaken and their appropriateness in regards to the community - Describes connection to and collaboration with population(s)/community(ies)/group(s) with whom this plan aims to work - Demographics are clearly defined as a group that qualifies as an underrepresented group (based on national or local evidence) - Includes evidence that the strategy will actually reach the target group - Demonstrated understanding of the appropriateness of the project in regard to age, grade, ability, and access	- Identifies target population as a homogenous group without acknowledging intersectionality - Mentions need for diversity in local community, campus community, or department community but provides limited demographics - Plan lacks consideration for strengths and needs of the population, or cultural competence - Limited description of collaboration with population(s)/community(ies)/group(s) with whom this plan aims to work - Limited or irrelevant demographic data provided - Limited evidence that the proposed strategy will reach target group - Limited details as to the appropriateness of the plan in regard to age, grade, ability, and access	-Rehashed Broader Impact Statements, does not address BPC - Does not describe the target population(s) - Focuses on a group that does not meet NSF's criteria for being underrepresented in computing - Confuses increasing participation in general (e.g., through outreach) with BPC - No description of collaboration with population(s)/community(ies/group(s) with whom the plan aims to work - Lists specific students working with PI as the only evidence that PI knows how to do BPC - No demographic data - Uses a deficiency lens (e.g., makes unsubstantiated claims that women need easier classes) -No details as to the appropriateness of the plan in regard to age, grade, ability, and access

Measurement & Dissemination		
Highly Developed *Potential for impact is high*	*Developed* *Evidence of potential impact*	*Undeveloped* *Potential for impact is low*
- Clear articulation of and cohesion between objectives/aims, activities, and evaluation metrics - Measurement plan uses the same specificity as the research goals and is supported by literature - Identifies metrics and instruments for assessment that draw on existing validated measures where available - Has a system for using the results from the data in an iterative process to strengthen efforts over time - Plans to measure both observable effects on target outcomes with a comparison group, as well as long-term or systemic changes where relevant - Involves an expert if needed/available to assist project - Describes current status (e.g., BPC in community, department, etc) and impact of plan on this status - Has a clear plan for sharing the results with both the target community and the broader BPC community	- Connection between evaluation metrics and the objectives/aims and activities is loose or unclear - The measurement strategies (e.g., which surveys will be used) are not described - Metrics/assessment and measures of success not tied to key components of plan - No details on current status (BPC in community, department, open BPC projects) and impact of plan on this status - Collects data at only one time point with no comparison group, or limited context for data comparisons - Assessment is planned for some but not all of the proposed activities - Assessment plan goes beyond the scope of the proposed activities, team capacity, or budget - System for using the results from the data lacks specificity - Dissemination plan does not include sharing evidence of success with population served or larger BPC community	- Lacks goals/objectives and measures to assess success - Provides no measurement plan - Lacks a dissemination plan

APPENDIX D: SAMPLE BPC PLANS DEEMED "EXEMPLARY"

These plans are included to help PIs understand the characteristics of strong BPC plans. They are intended to capture characteristics that reviewers have deemed to be exemplary (but are written carefully to be distinct from any actual plans). In many cases, successful plans were submitted by larger project teams that included some personnel who were already involved in BPC activities. Not all proposals will have such large teams and not all proposals will come from PIs with prior experience in BPC. Indeed, not all submitted plans are expected to reach such "exemplary" status; instead, they will be evaluated on the extent to which they represent a step forward for inclusivity based on the project team's resources and experience, and within context of the institutions and organizations in which they operate.

Exemplary BPC Plan 1: Explorations in Computing for K-12 with Broad Participation

This BPC plan comes from a multi-PI, multi-university collaboration and the proposed interventions focus on women and minorities. *[The proposal cites literature in listing several impediments to the success of women, African American and Latinx students in CS, each of which is specifically addressed in formulating and implementing the proposed interventions.]* The work will have two phases: in the first, a diverse team of graduate and undergraduate students will develop original materials for outreach with particular attention to computing topics that may be appealing to women and minorities. The second phase will employ those materials in a range of outreach programs.

Phase 1: The project will develop teaching materials and demonstrations aimed at high-school students and geared to engaging females and minorities. *[The proposal then gives examples of specific research topics and types of algorithms that might be explored in a variety of areas including DNA sequencing and social network analysis.]*
    The development will be assisted by a team of undergraduates across the participating institutions selected so that underrepresented students will make up at least half of the positions. The experience of working together itself will be designed to enhance the self-efficacy of the students and educate them about the value of inclusive environments. *[The proposal then describes the plans for recruitment of underpresented students.]* At institution X, the team will be recruited from the ranks of students in the following courses *[…]* and student groups *[…]*. At institution Y, the team will be assembled from the undergraduate students involved in *[…]*. At institution Z, the team will be assembled from the undergraduate students in courses *[…]*.
    The research topics that will be explored in this material are chosen to be authentic, have intellectual depth, and be appealing to the broader public with the hope that they will stimulate the academic interests in the emerging area of data science and STEM education in general. *[The reviewers liked the inclusion of both graduate students and undergraduates in the BPC plan.]* The PIs, their graduate students, and undergraduates involved in the research components of this proposal will share and jointly develop ideas for these outreach materials and projects. The materials will be demonstrated in hands-on exhibits at … *[Different STEM-related events held at each of the participating universities were listed along with estimates of the numbers of students potentially reached in each venue.]*.

Phase 2: The materials developed in Phase 1 will be transitioned to existing outreach programs at each of the collaborating institutions. At institution X, the materials will be used

in displays and as the basis for projects for a week-long, on-campus summer camp *[…]* and an in-school STEM enrichment program *[..]*. At institution Y, the materials will be presented in a lecture and mini-research experience as part of a a three-week summer academy for high school students. At institution Z, the PI and his students will transition the materials into 10-week summer research projects for Undergraduate Research Experiences (REU) students interested in exploring new data-driven approaches to interdisciplinary challenges—students will join one of two small project teams working on *[… and …]*, and they will learn how to *[…]* gaining broad exposure to the modern world of data science.

Metrics: The number of female and minority undergraduate students, and the number of undergraduate students overall, involved in the material preparation, the demonstration events, and the summer activities. *[Targets given for each category.]*

Exemplary BPC Plan 2: Broader Inclusion in Computing

This BPC plan adds a computing focus to *Excite!*, a multi-year, cohort-based, undergraduate STEM program that already exists on the PI's campus. *Excite!* features Student Expos, peer mentoring, REUs, and senior cohort capstone projects, all with the goal of attracting members of *[targeted underrepresented group]* to computing careers. The program offers community-centric learning, research, and development experiences based on the social and relational aspects of learning that have been shown to be most effective for academic engagement and persistence in the sciences. *[Relevant research and federal reports are discussed and cited here.]* The goal is to create a sense of CS identity, belonging, and teamwork.

This project adds a CS thread to *Excite!*, forming *Excite!*-CS, by recruiting and nurturing cohorts of students from *[the targeted group]* with an interest in CS, and increasing the awareness of CS among all of the students participating in *Excite!*.

Overview of the proposed program is:

Student Expos: Student Expos will be held once a semester to recruit freshman and sophomore students for the *Excite!*-CS cohorts. The Expos will be designed with CS activities organized in collaboration with local chapters of *[National/Professional Societies of the target group (e.g., NSBE, SWE, etc)]*. A range of activities will be offered including student-led research presentations, invited speeches, career discussions, and lab visits. *[Citations are given on the effectiveness of these types of activities.]*

Peer Mentoring: [Citations from the literature on the role of mentoring in student success.] A CS graduate student mentor will be assigned to each cohort of *Excite!*-CS students, in order to provide personalized mentoring through continuous engagements over the course of the students' four-years. Students in their Junior and Senior years will receive additional one-on-one mentoring in from the PI, who will meet with them regularly to discuss courses, research and/or design projects, and career paths.

REUs: According to *[Citation]*, exposure to traineeships and practical work are among key elements to sustain interest in STEM *[among students from the targeted minority]*. Top performing students will be selected for 10 week summer REUs with the PI and CoPIs serving as faculty mentors. *[Examples of the types of projects that students might pursue are given.]*. For such projects, students will be required to study literature and explore different research approaches. Graduate student mentors will monitor continuous progress and provide necessary

resources. The structure of the experience will be modeled on that of the CRA-W CREU and DREU programs *[Citations to CREU and DREU are given along with the adaptation of the programs that are being made here.]* At the end of the experience, students will be required to report findings in a 6-page report and a presentation.

Capstone Design Projects: The *Excite!*-CS practical learning experience will culminate in a cohort-wide capstone design project. Students, working together, will pursue projects that include both theoretical underpinnings and practical work. They will be given full access to labs for hands-on experience and problem-solving. They will be made aware of the established research methodologies, processes and latest outcomes. *[Examples of possible projects and problems are given.]*

Evaluation of proposed educational activities will be conducted through participation and exit surveys in years 2, 3, and 4 of the project. The evaluation queries and method related to each proposed educational activities are summarized below:

Education Activity	Student Expos	Peer Mentoring	REUs	Capstone Projects
Evaluation Questions	*[Each row of this column lists an evaluation question related to expected student outcomes (e.g. awareness of career opportunities, self-efficacy, belonging, and CS identity)]*			
Methods of evaluation	*[Each row of this column lists a mechanism for data collection needed to answer the stated question (e.g. pre- and post-surveys, focus groups, student interviews, student evaluations, course grades, and post-undergrad outcomes)]*			