

The following plan is in response to section 8.2 of the NSF Program Terms & Conditions. The HDRFS leadership team has updated the Broadening Participation plan, further demonstrating the project's deepened commitment to broadening participation and mentoring for project participants, from undergraduates to the leadership team. The revised plan focuses on improvements to retention, inclusivity, and interdisciplinary team building, including appropriate activities for students, postdocs, and faculty participants (both early-career and tenure).

HDRFS Broadening Participation Plan

The overarching goal of our Broadening Participation Plan is to create communities of practice focused on research and learning in our research teams, partnerships, and programs by employing best practices in mentorship, team science, and an effective culture of support. In response to section 8.2 of NSF's Programmatic Terms and Conditions for the Harnessing the Data Revolution for Fire Science (HDRFS), this plan provides details about the project's commitment to broadening participation and mentoring for project participants, from undergraduates to the leadership team. This plan will focus on improvements to inclusivity, interdisciplinary team building, and retention, and further outlines broadening participation activities for students, postdocs, faculty, and administrative participants.

Objectives. We will create communities of practice focused on research and learning in our research teams, partnerships, and programs by employing best practices in:

- Mentorship that fosters, among other things, inclusivity among participants in HDRFS programs
- Team science to build effective and connected interdisciplinary HDRFS teams
- An effective culture of support to optimize recruitment of retention and career advancement for HDRFS team members and participants in HDRFS programs

Theory of change. This high-impact broadening participation strategy will come to fruition as we create communities of practice (CoP) for research and education, which are defined as "group of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (Wenger 2002). CoP are social learning systems with three common elements: (1) a sense of joint purpose for interactions; (2) defined norms and relationships of mutuality as they interact; and (3) explicit development of knowledge related to their practice (Wenger, 2010). To put this theory into action, we will implement best practices in mentorship, team science, and an effective culture of support that provide formally structured and informal opportunities for collaboration and knowledge-building. These processes will include individuals with a range of experience levels, from novices and experts, who learn from one another and are able to put that knowledge into practice. In other words, we create opportunities for interaction that involve team members from a cross-section of levels in their career that result in mutual learning and career advancement. Key audiences in our Broadening Participation Plan are students (undergraduate and graduate), postdocs, early career and senior faculty, support staff, and administrators.

Mentorship that fosters (among other things) inclusivity. Mentorship is a high-impact strategy for promoting success across all career levels, including students, early career scientists, staff, research-engaged administrators, and senior faculty. Tiered mentorship involves "nested" mentor-mentee relationships along the arc of a typical career path in science, which can include near-peer mentorship between graduate students and undergraduates, or postdocs and graduate students. Meanwhile, the mentors of those at the student level are simultaneously mentees of early and middle career scientists. Senior scientists have a key role as both mentors of early and middle career scientists, and as learners in how to develop and share their own skills as mentors. Tiered mentorship is a common yet impactful strategy to stimulate learning and development across stages of career development while tailoring the nature of the learning relationship to the needs of those involved.

Mentorship in HDRFS will also help narrow diversity gaps with specific focus on the advancement from undergraduate to graduate, graduate to postdoctoral, and postdoctoral to faculty levels as well as non-traditional paths to engaged administrative or staffing roles. This work will help reduce barriers to the advancement for students from groups that are underrepresented in STEM by offering access to mentors, support in career planning, and opportunities to increase familiarity with the

norms of science and modern scientific support. Our plan will support broadening participation of underrepresented minorities and first-generation college students into academic culture.

We will coordinate with HDRFS research faculty, NSHE campus programs, such as Multicultural STEM programs, Offices of Undergraduate Research and Graduate Schools/Colleges, in order to provide these near-peer, tiered mentorship opportunities and trainings in effective research mentoring methodologies. In years 2-5, participants in HDRFS UROPs, graduate assistantships, and postdoctoral fellowships will be placed into small groups to engage in professional networking and mentorship opportunities. For example, groups will engage in organized events to navigate the explicit and 'invisible rules' of succeeding in academia and advancing to the next professional level; provide feedback on conference presentations and proposal ideas; provide guidance on emerging non-traditional professional pathways; and build subject-based professional networks that will be sustained beyond the duration of the grant.

To foster learning among later-career scientists and administrative personnel, and institutionalize systemic support for mentoring throughout NSHE, we will work with national programs like National Research Mentoring Network and the Council on Undergraduate Research to facilitate **Mentoring Institutes** in Years 2-5 to provide a forum to address opportunities to advance research mentoring statewide. Administrators, faculty, and students (**25-30/yr**) will gather to address topics like growing equity and inclusion, cultivating ethical behavior, enhancing work-life integration, promoting mentee research self-efficacy, and promoting professional development. These build on the outcomes of the 2020 and 2021 *Mentoring Institute: Growing Leadership & Support in Research within NSHE*, supported under the previous Track 1. Currently funded development of The Nevada STEM Mentor Network and Pathways to STEM Nevada websites will continue to provide access to Nevada mentors and students looking for research projects in the STEM fields and resources to search STEM opportunities in Nevada.

Team science to build effective and connected interdisciplinary teams. "Team Science" refers to an organizational approach to research that emphasizes cross-disciplinary functionality over siloed work. Generally recognized as a collection of practices that organically result in new approaches and solutions to science problems, Team Science emphasizes relationship-building, trust, transparency, boundary-spanning, and open communication. As such, it is not automatically prescriptive, and heavily dependent upon collaborative mindsets in each participant for success. By engaging best practices for Team Science, the HDRFS project will provide an atmosphere and platform upon which our collection of experts can truly become a team.

To proactively foster an environment where good collaborators can shine, we recognize that collegiality and communication are a key basis for productivity and the impact of our research.

We will design a structure and schedule for team interaction within the HDRFS project that provides opportunity and incentive for individuals to participate across all functional component group activities. This includes coordinated regular component meeting times and templates, shared document/resource access, rotating meeting leader/facilitator schedules, "share your work" activities integrated in regular meetings for personnel exchange, mechanisms for cross-component co-authorship, and clear project structure for conflict resolution. Our project design has sought to include key team members on multiple teams covering a range of experience such as fire processes and machine learning, based on cross-disciplinary research questions around which interdisciplinary teams are created.

Our communications platforms, project meeting scheduling, incentives for co-authorship, integration of task responsibilities, tiered mentoring approach, and conflict resolution planning are all driven by the Team Science philosophy.

An effective culture of support to optimize retention and career advancement

Project researchers, students, support staff, administrators, and post-docs will be motivated to join the team and stay if the culture around them is supportive, productive, and predictable. Our team culture is shaped by project communications, team activities, project management structure, and community interactions.

Our desired team culture is also shaped by an intentional philosophy that administrative and technical support structures, including project management and institutional processes, remain low-hassle and beget motivation to participate and excel.

With awareness of the above, we have identified several key areas to support an effective culture: First, we will support progress of team members through a combination of recognition, workload expectations, administrative mandates, technical assistance, open communication, and transparent processes. We will ensure early career researchers have access to the assistance they need to succeed, including professional development and mentorship opportunities. This includes integration into manuscript and proposal writing activities, and access to technical writing support. Second, we will foster team cohesion in ways that increase relationship-building among the team and provide support to members to thrive as part of research teams. This includes leveraging the networking opportunities that are available through workshop and invited speaker series to ensure our research team can interact with other research groups. Finally, we will create a culture that learns and adapts by soliciting feedback from team members on the challenges or roadblocks they face in their work, teaching, and quality of life.

Connections to the Research Plan

Table 1. Logic Model for Broadening Participation.

	Activities	Outputs	Outcomes	Metrics
Mentorship	<ul style="list-style-type: none"> • Pre-service teacher mentorship & classroom engagement (CSME, NevadaTeach, Marti, Fitzgerald) • Engagement with Title I schools with new curriculum (ScienceAlive) • Data analytics internship mentor-mentee pairs (Collins) • Undergraduate research opportunity mentorship (Casella) • Graduate student mentorship (PIs) • Tiered mentoring & professional development groups for undergrads, grads and postdocs (Casella, OURs, Graduate Schools) • Mentoring Institutes for NSHE faculty and administration (Casella) 	<ul style="list-style-type: none"> • Establishment of new mentor-mentee relationships across multiple levels (tiers) • Career development of diverse, aspiring future scientists and educators through mentorship • Creation of sustainable tiered mentorship approach across multiple levels (high school, PUI, undergraduate, graduate, scientist) • Development of mentorship infrastructure on NSHE campuses for support of faculty and students to engage in research 	<ul style="list-style-type: none"> • Inclusivity • Inclusion of both urban and rural students in HDRFS programs • Inclusion of broad student demographic groups in HDRFS programs • Involvement of community college • Institutionalization (capacity built) for tiered mentorship and career development experiences 	<ul style="list-style-type: none"> • Number of individuals serving as mentors • Individuals served as mentees • Number of Title I schools engaged • Number faculty trained • Number of administrative staff engaged
Team science	<ul style="list-style-type: none"> • Master project meeting design (templates, rotating facilitators, & coordinated calendar) • Common project administrative workspace & tools (M365/Sharepoint, Slack, Zoom) • Integrated team exchange activities (3 slides, 5min in scheduled component meetings) • Co-authorship incentive 	<ul style="list-style-type: none"> • Uniform approach to team activities • Shared responsibilities in leading meetings • Cross-discipline information and status exchanges • Create opportunities for initiative by faculty, students, post-docs, and staff alike 	<ul style="list-style-type: none"> • Interdisciplinary team building • Coordinated and predictable project operations • Shared tasks lead to efficiencies and shared success • Provides purposeful knowledge exchange for project resiliency • Allows individuals to seize opportunity for new collaborations 	<ul style="list-style-type: none"> • Number of project participants leading/facilitating meetings • Number of components per publication/proposal/student committees • Standard logs of all regular component meetings

	<ul style="list-style-type: none"> • & mechanisms • Conflict resolution pathway (PIs) • Team Science workshops (external, potentially internal) 	<ul style="list-style-type: none"> • Learn more about Team Science best practices outside of Nevada 	<ul style="list-style-type: none"> • Advances how Nevada science functions across institutions 	<ul style="list-style-type: none"> • Number of flash talk exchanges • Number of workshops attended
An effective culture of support	<ul style="list-style-type: none"> • Effectiveness & satisfaction evaluation process • Networking & relationship building opportunities • Invited Seminars & Talks • External Visitor Program • Grants excellence activities & support (senior faculty & staff) • Administrative & Technical support (professional staff) • Consulting & internal advocacy opportunities (senior leadership) 	<ul style="list-style-type: none"> • Mechanism for communication between all team members for feedback & administrative assistance • Pathways for communication with outside groups • Opportunities for junior scientists and researchers to connect with established researchers • A pipeline for junior researchers to become independent investigators and establish their own funded research 	<ul style="list-style-type: none"> • Successful recruitments • Retention & career advancement • Empowerment for self-directed success • More efficient work toward project goals • Common understanding & team belonging 	<ul style="list-style-type: none"> • Results of team satisfaction evaluations • Number of invited speakers/events • Number and quality of outside visitors • Number of submitted proposals by junior team members as PIs • Number of professional meetings and events attended by team members

Evaluation:

The BP component lead (Casella), with input from HDRFS leadership (Collins, Harris, Moosmüller, Stephen, Strachan, Tavakkoli), will work with EDU Inc. (external evaluation) to develop tools to evaluate activities, outputs, outcomes, and metrics. Evaluation, editing, and reporting will be done YRs 1-5 of the project.

References cited:

Wenger, E., R. McDermott, and W. Snyder. 2002. *Cultivating Communities of Practice*. Harvard Business School Press. Boston, MA. 2002.

Wenger, E. 2010. *Communities of Practice and Social Learning Systems*. *Organization*, 7, 225–246.