

# CAISE Guide to Resources for Broadening Participation in STEM

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A workshop report by the Center for Advancement of Informal Science Education (CAISE) & the Association of Science-Technology Centers (ASTC)

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## About CAISE

The Center for Advancement of Informal Science Education (CAISE) is a National Science Foundation (NSF) Advancing Informal STEM Learning (AISL) program-funded center based at the Association of Science and Technology Centers (ASTC) in Washington, D.C. CAISE is charged with providing resources and connectivity for those designing, evaluating and researching informal STEM learning experiences and settings. Since 2012, the Center has been collecting, curating and cataloging project descriptions, evaluation reports and research materials on the [InformalScience.org](http://InformalScience.org) website, the largest and most diverse repository of Informal STEM education field knowledge in existence. As a steward of the growing knowledge base derived from projects implemented and studied across the many sectors of organizations and professionals working outside of the formal classroom, CAISE seeks to highlight and disseminate success stories as well as provide in-person and online opportunities to catalyze new thinking and relationships.



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## CAISE Guide to Resources for Broadening Participation in STEM

This guide is intended to provide a starting point for those developing proposals and projects designed to broaden participation in science, technology, engineering and mathematics (STEM) through informal learning experiences. It is an outcome of an Association of Science-Technology Centers (ASTC)/Center for Advancement of Informal Science Education (CAISE) digital resource curation workshop (August 5, 2016) where participants identified relevant projects from the [InformalScience.org](http://InformalScience.org) database.

**For project leaders**, this guide offers examples of diverse strategies from past and current projects upon which new efforts to broaden participation can build. In addition, the guide identifies an initial set of publications for starting a research literature review; websites with relevant resources; and professional organizations devoted to broadening participation.

**For research scientists**, this guide can help identify informal science education (ISE) institutions with experience in and capacity for collaborating on outreach and public engagement activities designed for underrepresented audiences. General orientation the field can be found on InformalScience.org at [What is Informal Science?](#) For resources to address Broader Impacts in particular, see the [Scientists and Public Engagement page](#).

**For evaluators**, the guide contains links to examples of prior evaluation findings and reports, largely summative. In the list of selected publications, the *Framework for Evaluating Impacts of Broadening Participation Projects* (Clewell & Fortenberry, 2009) may be of special interest. Also, [Project Outcomes Reports](#), required by NSF since 2010, may contain further information on project findings, outcomes, and outputs.

## Role of the National Science Foundation (NSF)

As noted by NSF's Assistant Director for Education and Human Resources, "U.S. STEM education efforts are not fully drawing upon the full scientific potential of all demographic groups and populations" (Ferrini-Mundy, 2013). Achieving diversity and inclusion poses an increasingly critical challenge to the health of the scientific and engineering enterprise and to our nation.

To address this problem, NSF has sought for many years through most directorates and divisions across the Foundation to "[broaden participation](#)." Seeking to build on these prior awards and attain national scale, in 2015 the agency launched an aspirational multi-year initiative, NSF INCLUDES: "Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science". The long-term goal of NSF INCLUDES is to support, over the next ten years, innovative models, networks, partnerships, and research that enable the U.S. science and engineering workforce to thrive by ensuring that women, members of racial and ethnic groups that have been historically underrepresented in STEM (African Americans/Blacks, Hispanic Americans, American Indians, Alaska Natives, Native Hawaiians, Native Pacific Islanders), persons of low socio-economic status, and people with disabilities are represented in percentages comparable to their representation in the U.S. population.

The grand challenge of broadening participation in STEM is to transform the overall ecosystem at all levels in order to fully engage the nation's talent for the ultimate improvement of the nation's STEM capacity. Viewing this challenge as a social innovation problem, the objective is to develop networks that involve organizations and consortia from different sectors that are committed to a common agenda to solve the STEM inclusion problem at scale. ([NSF 16-081](#))

For further information: [NSF Includes](#); [NSF Broadening Participation](#); [NSF Committee on Equal Opportunities in Science and Engineering \(CEOSE\)](#); [Design and Development Launch Pilot Awards](#).

## Role of Informal STEM Learning

***With respect to addressing the goal of broadening participation, “informal environments can have a significant impact on science learning outcomes for individuals from nondominant groups who are historically underrepresented in science.” (National Research Council, 2009, 301) Since informal learning experiences are especially well suited to developing interest in STEM and fostering identity as a STEM learner, they can offer alternative pathways that are complementary to formal learning.***

Informal science institutions can therefore play key roles in efforts to broaden participation within their communities. To amplify their impact, they can work closely with other elements of the STEM learning ecosystem, including schools, community based organizations, afterschool providers, higher education institutions, and businesses, along with experiences delivered via digital media and the home (National Research Council, 2014).

The “collective impact” model (Kania & Kramer, 2011) offers an approach to promote synergy among multiple diverse organizations through sharing a common agenda, measurement systems, mutually reinforcing activities, continuous communication, and backbone support organizations. To jump-start the formation of a national Community of Practice around this model, the STEM Funders Network has provided \$20 million to support a first cohort. The 2015 launch of the [STEM Learning Ecosystems Initiative](#) included 27 communities in 18 states that involve 15 million students, 600,000 educators in 576 school districts, and 1,000 informal and afterschool organizations.

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## Informal STEM Education Broadening Participation Projects

The NSF-funded awards listed here are drawn primarily from the Informal Science Education (ISE) and Advancing Informal STEM Learning (AISL) portfolios. They are illustrative of projects in the [InformalScience.org](#) repository and do not include all relevant work. Although these projects are organized by primary intended audience, the groups targeted may not be limited to one category and often overlap.

Each project is linked to a page on the [InformalScience.org](http://InformalScience.org) website that includes at minimum, the award abstract, lead organizations, principal investigators (PIs), and often other resources in the database, such as an evaluation report or a project poster from a principal investigator (PI) meeting or conference. The list is intended to serve as a starting point; further information on a project of interest may be available elsewhere online or by contacting the PI. Additional projects can be found by searching with keywords such as access and inclusion. Awards can also be searched at [NSF Award Search](http://NSF Award Search) and Purdue University's [DIA2 \(Deep Insights Anywhere, Anytime\)](http://DIA2 (Deep Insights Anywhere, Anytime)).

*Note:* Projects in the [InformalScience.org](http://InformalScience.org) database were identified by metadata tags defined by a CAISE-convened infrastructure coordination roundtable working group; these continue to be refined to best reflect changing perspectives on access and inclusion. Emphasis was placed on projects from the past decade with demonstrated outcomes. More recent projects were also included to indicate directions currently being pursued.

## Women & Girls

0125765: [\*Thinking Smart\*](#)

Girls Inc. modules, mentoring, training, online activities and awards program

Evaluation profile: <http://hfrp.org/out-of-school-time/ost-database-bibliography/database/girls-incorporated-thinking-smart-program>

0452419: [\*The Impact of Informal Science on Girls' Interest, Engagement and Participation in Science Communities, Hobbies and Careers: A Research and Dissemination Project\*](#)

Study of five long-standing programs for girls framed by Community of Practice literature

Resources: *Cascading Influences* report

0550710: [\*Extraordinary Women Engineers\*](#)

Nationwide outreach effort to encourage girls to consider engineering

Resources: evaluation reports

0638909: [\*Project WISE: Working in Informal Science Education\*](#)

University/museum partnership to provide cross-age collaborative exhibit development experience related to flight with emphasis on role of women

Article: <http://jstem.org/index.php?journal=JSTEM&page=article&op=view&path%5B%5D=1484>

0741737: [\*Out of this World\*](#)

Cross-media package with website, radio programs, and museum events on U.S. space program highlighting women and African-Americans

Project website: <http://capecosmos.org>

Evaluation: <http://www.informalscience.org/summative-evaluation-soundprint's-out-world-project>

0753686: [\*New Image for Computing\*](#)

Messaging campaign to reshape perception of computing among college-age girls

Project website: <http://dotdiva.org>

Resources: pilot test results

1039546: [\*Addressing Gender Barriers in STEM through Theatre of Social Engagement\*](#)

Dramatic play involving three young women graduating from high school who make decisions about possible careers in Information Technology

Project website: <http://www.idreamtheplay.com>

1103016: [SciGirls CONNECT](#)

National network to encourage educators to adopt research-based strategies to engage girls in STEM

Project website: <http://scigirlsconnect.org>

Resources: evaluation reports

1103073: [National Girls Collaborative Project: Building the Capacity of STEM Practitioners to Develop a Diverse Workforce](#)

Extensive national network of girl-serving STEM organizations that facilitates collaboration and shares promising practice research, program models, and products

Project website: <http://ngcproject.org>

1114481: [Science STARS—Nurturing Urban Girls' Identities through Inquiry-Based Science](#)

Afterschool program that engages middle-school girls in authentic science and creation of a science documentary

Resources: presentation

1223460: [Using Narrative in a Digital Learning Environment to Engage Children and Teens in Engineering](#)

Development of young adult novels and multi-media learning adventures designed to deepen understanding of and enhance interest in engineering

Project websites: <http://www.throughmywindow.org>; <http://teamthroughmywindow.org>

Resources: toolkit for engineering educators

1224020: [Project STEAM: Integrating Art with Science to Build Science Identities Among Girls](#)

Activities and kits designed to inspire art-interested girls in STEM careers

Project website: <http://www.colorsofnature.org>

Resources: poster

1322306: [Designing Our World: A Community Envisioning Girls as Engineers](#)

Museum-based exhibits, girls' activity groups, and social media to enhance engineering-related interests and identifies

Resources: front-end evaluation, posters

1323306: [Advancing Informal STEM Learning Through Scientific Alternate Reality Games](#)

Research on design and development of two large-scale space-related games

Resources: evaluation, user assessment, poster

1323713: ["Citizen SciGirls" Transmedia and Research to Encourage Girls in STEM](#)

TV episodes featuring citizen science activities in collaboration with scientists

Project website: <http://pbskids.org/scigirls/>

Resources: evaluation, interest scale, posters

1323806: [Exhibit Designs for Girls' Engagement \(EDGE\)](#)

Research on female-responsive design principles to engage girls in STEM exhibits

Resources: design guide, posters

1421806: [The Role of Story in Games to Teach Computer Science Concepts to Middle School Girls](#)

Video game to interest girls in learning computer science outside traditional classes

Related website: <http://www.northeastern.edu/gramshouse>

Article: <http://nuweb1.neu.edu/gramshouse/wp-content/uploads/2014/09/PairingAnalogDigitalGames.pdf>

1515507: [\*Latina SciGirls: Promoting Middle School-Age Hispanic Girls' Positive STEM Identity Development\*](#)

TV episodes featuring girls working with mentors on culturally relevant science, along with associated activities

Project website: <http://scigirlsconnect.org>

Resources: poster

## **Low Socioeconomic Status/Urban Audiences**

0515494: [\*Fantasy Sports Games as Cultures for Informal Learning\*](#)

Online fantasy basketball as vehicle for statistical reasoning and decision-making

0610272: [\*Youth Radio Science and Technology Program\*](#)

Train and engage underserved young people in broadcast journalism, radio and web production, engineering, and media literacy through relevant media projects

Resources: evaluation

0610350: [\*Youth Astronomy Apprenticeship—An Initiative to Promote Science Learning Among Urban Youth and Their Communities\*](#)

Connect youth to astronomy through a traditional apprenticeship model

Resources: evaluation

0638981: [\*Out-of-School Time STEM: Building Experience, Building Bridges\*](#)

Trends, questions, and findings related to OST STEM

Resources: report

0802913: [\*Chemistry in Afterschool—Partnership with CASTL and the Boys and Girls Club\*](#)

Engage students in activities developed by Center for Chemistry at the Space-Time Limit

Resources: evaluation report, poster, website

0812954: [\*Statistics for Action\*](#)

Enhance capacity of environmental organizations to teach math skills to low-income citizens

Project website: <http://sfa.terc.edu>

Resources: evaluation

1223531: [\*SUNY/NYAS STEM Mentoring Program Statewide Scale Up Project\*](#)

Grad students and postdocs mentor afterschool programs serving high-need urban communities

Article: [http://www.fasebj.org/content/29/1\\_Supplement/559.37](http://www.fasebj.org/content/29/1_Supplement/559.37)

Resources: poster

1224131: [\*Repurposing Obsolescence: Teaching DIY Science, Technology and Engineering Practices to Adolescents in Underserved Communities\*](#)

Hands-on workshops targeting Latino middle-school girls

Article: <http://fablearn.stanford.edu/2013/wp-content/uploads/Toy-Hacking-Preliminary-Results-in-Creative-Electronic-Workshops-for-Informal-Science-Education.pdf>

1238253: [\*A Research+Practice Collaboratory: Equity in Out-of-School STEM Learning: Professional Development Needs and Strategies\*](#)

Resources: report

[\*Making as a Strategy for Afterschool STEM Learning: Report from the California Afterschool Tinkering Network Research-Practice Partnership\*](#)

Related website: <http://www.exploratorium.edu/education/california-tinkering-afterschool-network>

Resources: report, evaluation

1323280: [\*Supporting a Community's Informal Education Needs: Confidence and Empowerment in STEM \(SCIENCES\) Program\*](#)

Broaden participation in environmental science using an “ecosystemic” learning model

Resources: posters

1323584: [\*Making Connections: Exploring Culturally-Relevant Maker Experiences Through an Iterative, Cross-Institutional Approach\*](#)

Design-based research study on engaging underrepresented groups in maker activities

Resources: poster

1423207: [\*Community-Driven Projects That Adapt Technology for Environmental Learning in Nature Preserves\*](#)

Engage members of diverse audiences in identifying and carrying out environmental projects

Resources: poster

1423612: [\*“Making” STEM Relevant in Underserved Communities\*](#)

Implement and evaluate a pilot Mobile Making program in an underserved youth population

1441523: [\*ScienceKit for ScienceEverywhere—A Seamless Scientizing Ecosystem for Raising Scientifically-Minded Children\*](#)

Mobile devices and strategic kiosks to “scientize” youth in low-income communities

1516718: [\*Synergies: Customizing Interventions to Sustain Youth STEM Interest and Participation Pathways\*](#)

Investigate engagement in STEM among youth from ages 10 to 15 in a diverse, under-resourced urban community

## **Rural Audiences**

1010577: [\*Pushing the Limits: Building Capacity to Enhance Public Understanding of Math and Science Through Rural Libraries\*](#)

Model for STEM education through local libraries in rural communities

Resources: evaluation reports, presentation

1010844: [\*STAR Library Education Network: A Hands-on Learning Program for Libraries and their Communities\*](#)

Traveling exhibits and programs, training, and a Community of Practice

Project website: <http://www.starnetlibraries.org>

Resources: evaluation, article, poster, presentation

1421427: [\*Phase 2 of the STAR Library Education Network\*](#)

Resources: STEM Resource Clearinghouse, educational games

1114467: [\*Native Universe—Indigenous Voice in Science Museums\*](#)  
Professional development to foster institutional change with focus on environmental change  
Resources: posters

1114558: [\*Herpetology Education in Rural Places and Spaces \(HERPS\)\*](#)  
Engages rural underrepresented groups in conservation and field experiences  
Project website: <https://theherproject.uncg.edu>  
Resources: Evaluation reports, research articles, education materials

1223703: [\*Contextualizing Science Learning and Motivation in Rural and Indigenous Adolescents through Mapping Sustainable Practices\*](#)  
Study of impacts of contextualization to culture and community  
Resources: project spotlight

1224093: [\*Science Source Pathways\*](#)  
Test efficacy of science news service targeting rural and Native American communities  
Resources: poster

1322827: [\*STEM Guides: Building Coherent Infrastructure in Rural Communities\*](#)  
Rural state-wide STEM mini-networks that facilitate local face-to-face interaction  
Resources: poster

1422917: [\*Walking in Two Worlds: Engaging the Community and Future Native American Scientists in Environmental Science and Managing Natural Resources on Tribal Lands\*](#)  
Engage community through holistic approach incorporating Western science and traditional knowledge

1515241: [\*Rural Gateways: Fostering the Development of Rural Librarians as Informal Science Facilitators\*](#)  
Online professional development of librarians to turn libraries into STEM learning centers

1516742: [\*Developing an Informal Environmental Health Education Model for Use in Tribal Communities\*](#)  
Tribal community framework based on Indigenous knowledge, practice, and learning styles using a First Foods paradigm

## **People with Disabilities**

1008546: [\*The Handheld Signing Math & Science Dictionaries for Deaf and Hard of Hearing Museum Visitors Research Project\*](#)  
Study visitor use of iPod-based dictionaries to access and communicate about an exhibition  
Project website: [https://test2-signsci.terc.edu/MoS\\_SMSD/index.htm](https://test2-signsci.terc.edu/MoS_SMSD/index.htm)  
Resources: article, evaluation reports, video clips

1042260: [\*AccessComputing\*](#)  
Broadening Participation in Computing Alliance  
Project website: <http://www.washington.edu/accesscomputing/>  
Resources: accommodations, articles, promising practices

## Selected Publications

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## Web Sites

These sites contain resources relevant to broadening participation.

[AccessSTEM Knowledge Base](#)

[ARC Center for Advancing Research & Communication](#)

[Beyond Rigor: Improving Evaluations with Diverse Populations](#)

[Community for Advancing Discovery Research in Education](#)

[The Inclusionum](#)

[National Girls Collaborative Project](#)

[Pathways to Science](#)

[Understanding Interventions](#)

## Professional Organizations

These organizations offer potential sources for contacts, partners, and further information regarding broader participation.

[American Indian Science and Engineering Society](#)

[Association for Women in Mathematics](#)

[Association for Women in Science](#)

[Building Engineering and Science Talent \(BEST\)](#)

[Center for the Advancement of Hispanics in Science and Engineering Education](#)

[Foundation for Science and Disability](#)

[Institute for Broadening Participation](#)

[MAES: Latinos in Science and Engineering](#)

[Mathematics Engineering Science Achievement \(MESA\)](#)

[Minorities in Agriculture, Natural Resources and Related Sciences](#)

[National Association of Multicultural Engineering Program Advocates](#)

[National Center for Women & Information Technology](#)

[National Organization for the Professional Advancement of Black Chemists and Chemical Engineers \(NOBCChE\)](#)

[National Society of Black Engineers \(NSBE\)](#)

[National Society of Black Physicists \(NSBP\)](#)

[Quality Education for Minorities \(QEM\)](#)

[SECME \(Southeastern Consortium for Minorities in Engineering\)](#)

[Society for Advancement of Chicanos/Hispanics and Native Americans in Science \(SACNAS\)](#)

[Society of Hispanic Professional Engineers](#)

[Women in Engineering ProActive Network](#)