



Working with STEM Experts:

A Guide for Educators in Museums and Other Informal Learning Settings

By Catherine McCarthy and Darrell Porcello

NISE
NATIONAL INFORMAL
STEM EDUCATION
NETWORK

www.nisenet.org



Copyright Arizona State University, 2021

Published under a Creative Commons Attribution Noncommercial-ShareAlike license:
<https://creativecommons.org/licenses/by-nc-sa/3.0/>

Suggested Citation: Catherine McCarthy and Darrell Porcello (2021). *Working with STEM Experts: A Guide for Educators in Museums and Other Informal Learning Settings*. NISE Network: Arizona State University. <https://www.nisenet.org/working-with-experts>

Special thanks for contributing to this guide: Larry Bell, Brad Herring, Ali Jackson, Frank Kusiak, Christina Leavell, Paul Martin, and Rae Ostman.

Thanks to the following individuals for reviewing sections of this document: Kayla Berry, Christopher Britt, Amelia Chapman, Jayatri Das, Kay Ferrari, Patricia Galvan, Keliann LaConte, Kal Mannis, Bonnie Murray, Jeff Nee, Daniella Scalise, Theresa Schwerin, Christine Shupla, Denise Smith, Elena Sparrow, Jessica Swan, Jessica Taylor, and Nicholas Weller.

FUNDING ACKNOWLEDGEMENTS

Multiple NISE Network projects contributed toward the content included in this guide:

This guide is based on work supported by the **National Science Foundation** under Award Numbers 0532536, and 0940143, DRL 1421179, and DRL 1612482. Any opinions, findings, conclusions, or recommendations expressed in this guide are those of the authors and do not necessarily reflect the views of the National Science Foundation.

This guide is based upon work supported by **NASA** under cooperative agreement award numbers NNX16AC67A and 80NSSC18M0061. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the view of the National Aeronautics and Space Administration (NASA).

This guide is made possible in part by the **Institute of Museum and Library Services**, Grant Number MG-245910-OMS-20. This program is a continuation of the Sustainability Fellowship program established through support from the **Rob and Melani Walton Foundation** as part of Arizona State University's Rob and Melani Walton Sustainability in Science and Technology Museums initiative.

This guide includes materials prepared using federal funds under award NA18SEC0080008 from **NOAA**. Any opinions, findings, and conclusions expressed in this material are those of the authors and do not necessarily reflect the views of NOAA or the US Department of Commerce.

Contents

About This Guide	6
Purpose and Intended Audience	6
About the NISE Network.....	6
SECTION 1	
Why Bring STEM Experts and the Public Together	7
<i>Introduction</i>	<i>7</i>
<i>Potential Impacts of Experts Engaging the Public.....</i>	<i>8</i>
Sharing a Passion for Science	8
Providing Opportunities for Mutual Learning.....	8
Understanding That Science Is a Human Endeavor	8
Increasing the STEM Workforce and Creating Career Pathways	9
Greater Representation of Women and Minorities in STEM Careers.....	10
Changing the Face of STEM—When You Picture a Scientist, Who Do You See?	10
STEM Identity and Providing Role Models and Mentors.....	11
STEM Literacy and Creating Lifelong Learners	12
More Trust in Science.....	12
Creating Opportunities for Participatory Democracy	12
<i>Understanding Motivations.....</i>	<i>14</i>
Experts’ Motivations for Public Engagement	14
Institutional Motivations to Partner with Experts in Public Engagement Efforts	15
SECTION 2	
Ways to Work with STEM Experts	16
<i>Formats for Public Engagement.....</i>	<i>16</i>
Special Events	16
Hands-On Activities	16
Guest Lectures, Talks, and Presentations	17
Science Cafés	17
Forums	17
Science Festivals	17
Virtual Formats	18
Mentoring	18
Joint Collaborative Projects	19
<i>Development Process Content Experts</i>	<i>20</i>
<i>Professional Development for Staff and Volunteers</i>	<i>20</i>
<i>Liaison Roles</i>	<i>20</i>
<i>Ongoing Advisory Roles</i>	<i>20</i>

SECTION 3

How to Prepare Experts to Engage Public Audiences	21
NISE Network Strategies and Guides for STEM Engagement Design and Implementation	22
Prepare Experts to Facilitate Hands-On Activities at an Event	23
Training Materials for NISE Network Hands-On Activities	24
NISE Network Training Videos	25
NISE Network Science Communication Tools for Scientists	26
<i>Annotated List of Resources</i>	<i>27</i>
Science Communication	27
Broadening Participation	28
Broader Impacts	29
Additional Useful Resources	29
Conferences and Initiatives	30

SECTION 4

Tips Sheets	31
<i>Tips for Planning Guest Presentations</i>	<i>33</i>
<i>Tips for Guest Speakers</i>	<i>34</i>
<i>Tips for Leading Hands-On Activities</i>	<i>35</i>

SECTION 5

Strategies for Finding STEM Experts	36
Strategies for Finding STEM Experts	36
<i>Where to Find Local STEM Experts</i>	<i>37</i>
Colleges and Universities	37
Student Groups	37
STEM Professional Societies	38
Diversity-Serving Professional Societies	38
Local, State, and Federal Agencies	39
Local Industry Professionals	39
Affinity Groups	39
Indigenous Ways of Knowing	39
Arts and Cultural Connections	41
Societal and Policy Experts	41
Additional Volunteers for a STEM Event	42
<i>Contacting Experts</i>	<i>43</i>
Steps for Inviting Experts to Participate	43
<i>Maintaining and Deepening Relationships</i>	<i>44</i>
Ways to Maintain Contact and Show Your Appreciation	44
<i>Reflecting on Your Experiences</i>	<i>45</i>

SECTION 6

Finding STEM Experts by Subject Area	46
<i>Chemistry and Physics</i>	47
<i>Space and Earth Science</i>	49
<i>Environmental Sciences</i>	
<i>Natural Resources, Ecology, Earth Sciences, Geology, Meteorology, Climate, and Sustainability</i>	52
<i>Agriculture</i>	
<i>Food Science, Animal Science, and Plant Science</i>	56
<i>Biology and Biomedical Sciences</i>	
<i>Genetics, Synthetic Biology, and Public Health</i>	58
<i>Neuroscience</i>	60
<i>Engineering, Technology, Material Science, and Nanoscale Science</i>	62
<i>Computer Science, Math, Statistics</i>	65
<i>Incorporating STEM into Arts and Cultural Celebrations</i>	67
<i>Image Credits</i>	68

About This Guide

Purpose and Intended Audience

This guide is written for informal science educator staff and volunteers at museums, science centers, children's museums, natural history museums, and planetariums located in the U.S. This guide may also be helpful for staff and volunteers at similar informal education institutions such as zoos, aquariums, botanic gardens, nature centers, parks, libraries, festivals, afterschool programs, etc. This document is intended to be a practical guide for how to find, prepare, and work with STEM experts. It includes suggestions for ways to include experts in STEM public engagement programming in informal learning settings.

We have divided the guide into the following sections:

1. Why Bring STEM Experts and the Public Together
2. Ways to Work with STEM Experts
3. How to Prepare Experts to Engage Public Audiences
4. Tips Sheets
5. Strategies for Finding STEM Experts
6. Finding STEM Experts by Subject Area

About the NISE Network

The National Informal STEM Education Network (NISE Net) is a community of informal educators and scientists dedicated to supporting learning about science, technology, engineering, and math (STEM) across the U.S. Our mission is to bring people together

to engage in STEM, understand our world, and build a better future for everyone. The NISE Network fosters collaboration and draws on the collective strengths of our partners.

We achieve our reach and impact through the participation of over 700 partner organizations in Network activities, including museums, universities, and other organizations that provide informal learning opportunities for public audiences. Network projects create educational materials and support professional learning, while Network partners implement project activities locally. Together, NISE Network partners engage 15 million people each year in high-quality STEM learning. As a professional community, we are committed to learning alongside each other and our partners, and to evolving the way we work as a result.



SECTION 1

Why Bring STEM Experts and the Public Together

This section provides a brief overview of the motivations and benefits for bringing STEM experts and the public together, and focuses on the rationale for informal science education institutions to foster STEM expert engagement with the public.

Introduction

Science and technology impact every aspect of our modern lives. A common assumption is that lack of science content knowledge leads most individuals to disregard scientific claims or support policies that are inconsistent with scientific evidence. The reality is that people do not make decisions based on only scientific information; they take into account their own goals, needs, knowledge, values, and beliefs.¹ Effective science communication conveys both complexity and nuance, and does so in a way that relates content to the lives of individuals, families, and communities. Public engagement with science goes beyond sharing facts and includes societal questions that science can inform but not answer, such as potential risks, benefits, and consequences. It also provides opportunities for interaction, two-way communication, and mutual learning.



Informal learning takes place across a multitude of settings and experiences outside the formal school classroom.² These informal learning settings can provide opportunities for experts to engage the public directly.

STEM experts have deep knowledge and understanding of a particular field of science, technology, engineering, or math. There are many reasons for having STEM experts directly participate in public education and engagement activities.³ Of course, experts

1 National Academies of Sciences, Engineering, and Medicine. (2017). *Communicating Science Effectively: A Research Agenda*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/23674>

2 For an introduction to research on informal learning see:

National Research Council. 2009. *Learning Science in Informal Environments: People, Places, and Pursuits*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/12190>.
<https://www.nap.edu/catalog/12190/learning-science-in-informal-environments-people-places-and-pursuits>

National Research Council. 2010. *Surrounded by Science: Learning Science in Informal Environments*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/12614>.
<https://www.nap.edu/catalog/12614/surrounded-by-science-learning-science-in-informal-environments>

3 For a more extensive discussion of impacts on experts see:

Portal to the Public (2018), Implementation Manual, Pacific Science Center and Institute for Learning Innovation. <https://popnet.instituteforlearninginnovation.org/resources/>

will often have more content knowledge about a specific topic than a museum educator or volunteer, but experts can offer much more beyond facts and information. The following is a summary of the major beneficial impacts for public audiences.

Potential Impacts of Experts Engaging the Public

- Sharing a Passion for Science
- Providing for Mutual Learning
- Understanding That Science Is a Human Endeavor
- Increasing the STEM Workforce and Creating Career Pathways
- Greater Representation of Women and Minorities in STEM Careers
- Changing the Face of STEM – When You Picture a Scientist, Who Do You See?
- STEM Identity and Providing Role Models and Mentors
- STEM Literacy and Creating Lifelong Learners
- More Trust in Science
- Creating Opportunities for Participatory Democracy

Sharing a Passion for Science

Having experts engage with the public can be a compelling way for people to learn about a fascinating subject from someone who is personally immersed in the topic. In addition to sharing content and

knowledge, experts have the potential to convey the excitement, enthusiasm, a sense of wonder, and passion they feel for their subject. Experts may also share stories about the curiosity that sparked the interest in the work they do. These interactions have the power to provide memorable, meaningful, and fun experiences for members of the public.

Providing Opportunities for Mutual Learning

Public engagement with science can go further than the one-way dissemination of content by including opportunities for two-way communication and mutual learning and conversations.^{4,5} Museums and other informal learning spaces can provide a convening place for these kinds of interactions and conversations to occur. Both scientists and publics can listen to each other and learn from one another, and both have expertise, valuable perspectives, and knowledge to contribute to the development of science and its application to society. This multidirectional learning is especially crucial for topics that lie at the intersection of science and society at a time when scientific and technological breakthroughs have wide-ranging impacts on everyone in our world.

Understanding That Science Is a Human Endeavor

Science is not neutral; it is a deeply human process. The Next Generation Science Standards remind us that “science and engineering are influenced by society” and that “scientists’

4 Bell, L., Lowenthal, C., Sittenfeld, D., Todd, K., Pfeifle, S., and Kollmann, E. K. (2018) *Public Engagement with Science: A guide to creating conversations among publics and scientists for mutual learning and societal decision-making*, NISE Network. <https://www.nisenet.org/public-engagement-conversations-guide>

5 McCallie, E., Bell, L., Lohwater, T., Falk, J. H., Lehr, J. L., Lewenstein, B. V., Needham, C., and Wiehe, B. (2009). *Many Experts, Many Audiences: Public Engagement with Science and Informal Science Education. A CAISE Inquiry Group Report*. Washington, DC: Center for Advancement of Informal Science Education (CAISE). <https://www.informalscience.org/many-experts-many-audiences-public-engagement-science>

backgrounds influence their findings.”⁶ We know that systemic injustice is present in the teaching, learning, and practice of science, both historically and today.⁷ The fact that learning and participating in STEM is not as equitable and inclusive as it should be is a moral problem that needs to be addressed by all of us. Public engagement with science moves us closer to these goals. STEM professionals not representing society as a whole also affects the content and quality of work; diverse teams have been found to have many benefits, including better problem-solving and more impactful research.^{8,9}

Increasing the STEM Workforce and Creating Career Pathways

In the U.S., there is a high demand for qualified professionals in many STEM fields, and a shortage in some STEM fields.¹⁰ In the past, the STEM workforce pipeline was a popular metaphor describing the linear progression of learners interested in STEM topics through a sequence of educational phases toward a career in STEM. The “leaky” pipeline described the disproportionate exit of girls and minorities along the way, leading to their ultimate underrepresentation in the STEM workforce. In recent years, people have called for moving beyond the pipeline metaphor toward a more progressive pathway approach. Aspects of this approach focus on finding personal meaning and relevance, and making STEM more inclusive and welcoming to people of all backgrounds—a common goal in many leading examples



6 National Research Council. (2013) *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/18290>. <https://www.nap.edu/catalog/18290/next-generation-science-standards-for-states-by-states>

7 Rifkin, M. (2020) Who Does Science?, *The Science Teacher*, July/August 2020 (Volume 87, Issue 9). <https://www.nsta.org/science-teacher/science-teacher-julyaugust-2020/who-does-science>

8 Freeman R.B and Huang W. (2014) Collaboration: Strength in diversity. *Nature* 513 (7518): 305. <https://www.nature.com/articles/513305a>

9 Stetler, R. L., Kupersmidt, J. B., and Stump, K. M. (2020) Establishing Effective STEM Mentoring Relationships through Mentor Training, *Ann. N.Y. Acad. Sci.* 1483 (2021) 224-243. New York Academy of Sciences. <https://nyaspubs.onlinelibrary.wiley.com/doi/epdf/10.1111/nyas.14470>

10 Xue, Y. & R. Larson. (2015) STEM crisis or STEM surplus? Yes and yes. *Monthly Labor Review*. <https://doi.org/10.21916/mlr.2015.14>

of public engagement programs. This change from a fixed pipeline may convince more people to stay in STEM programs and careers, offering more flexible opportunities rather than a linear progress, and understanding obstacles and supports necessary in a more equitable system.^{11,12} A diverse group of experts can help connect with all public audience members.

Greater Representation of Women and Minorities in STEM Careers

To make science more connected and responsive to our ever-changing society, it is imperative that people of all backgrounds have the opportunity to pursue STEM careers. Currently the STEM workforce is not representative of the diversity of the U.S. population.^{13,14} Although there have been gains in earning educational degrees over the past



two decades, women, people with disabilities, and underrepresented minority groups (African Americans, Hispanics, American Indians, and Alaska Natives) are still underrepresented in science and engineering careers compared with their representation in the U.S. population. Women are still

starkly underrepresented in computing and engineering education and jobs; in 2016, women earned only about 20% of bachelor's degrees in computing, engineering, and physical sciences. Underrepresented minorities comprise 27% of the U.S. population; the share of science and engineering bachelor's degrees awarded to underrepresented minorities in 2016 increased significantly over the prior twenty years, from 14% to 22%; however, doctorate degrees remain at only 9%. Engagement with experts can help encourage diverse learners to start or continue pursuit of a career in STEM.

Changing the Face of STEM—When You Picture a Scientist, Who Do You See?

Scientists we see in the media, movies, online, and in person become the face of science for the public. This influences our perception of who does science, whom science is for, and who can become a scientist. A 2018 study analyzing five decades of studies of U.S. school-age children's drawings of scientists found that the children's depictions of scientists have become more gender diverse over time. In some of the 1960s and 1970s studies on this issue, less than 1% of children drew a picture of a woman. Typically, when asked to draw a picture of a person, usually 70% or more of both boys and girls draw their own sex. Recent Draw-A-Scientist studies found that 58% of girls and 13% of boys drew pictures of women. Recent studies also show that as children grew older, both girls and boys drew male scientists more often, reflecting their increased gender-science

11 Lyon, G. H., Jafri, J, St. Louis, K. (2012) Beyond the Pipeline: STEM Pathways for Youth Development, *Afterschool Matters*, n16 p48-57 Fall 2012. http://www.niost.org/pdf/afterschoolmatters/asm_2012_16_fall/ASM_2012_16_fall_6.pdf

12 Gibbs, K. (2014) Beyond "The Pipeline": Reframing Science's Diversity Challenge, *Scientific American*, December 17, 2014. <https://blogs.scientificamerican.com/voices/beyond-the-pipeline-reframing-science-s-diversity-challenge/>

13 National Science Foundation, National Center for Science and Engineering Statistics. (2019). Women, Minorities, and Persons with Disabilities in Science and Engineering: 2019. Special Report NSF 19-304. Alexandria, VA. <https://nces.nsf.gov/pubs/nsf19304/>

14 Kennedy, B, Richard Fry, R. and Funk, C. (2021) 6 facts about America's STEM workforce and those training for it, Pew Research Center. <https://www.pewresearch.org/fact-tank/2021/04/14/6-facts-about-americas-stem-workforce-and-those-training-for-it/>

stereotypes as they age.¹⁵ Public engagement can have an impact on perspectives on gender and science. The following are a few recent powerful examples of how people are working to change public perceptions of scientists.

- The 2020 documentary film “Picture a Scientist” chronicles the path of several women in science and offers perspectives on how to make science itself more diverse, equitable, and open to all: <https://www.pictureascientist.com>
- The 2021 documentary “Not the Science Type” explores the negative impact stereotypes can have on STEM diversity, equity, and inclusion, and is meant to inspire hope and a sense of possibility: https://www.3m.com/3M/en_US/state-of-science-index-survey/not-the-science-type/
- The IF/THEN® initiative is designed to shift cultural perceptions of who works in STEM and to interest girls in the possibility of a STEM career. Resources include the This Is What A Scientist Looks Like™ campaign, AAAS Ambassadors, and a collection of royalty-free images: <https://www.ifthenshecan.org>
- “I Am A Scientist,” digital tools, images, and posters to make STEAM careers technically and psychologically accessible to all students: <https://www.iamascientist.info>



STEM Identity and Providing Role Models and Mentors

STEM identity is how people think about themselves as science learners and how they develop an identity as someone who knows about, uses, and can contribute to science. A science identity increases the likelihood that participants “continue to develop science literacy or even follow an educational pathway toward a science career or profession that requires or benefits from education or training in STEM.”¹⁶ Having a STEM identity influences a learner’s expectations of how interesting and successful the experience will be and if they choose to participate in STEM-related activities in the future.

With the exception of medical practitioners, many members of the general public have little personal familiarity with STEM experts and many have never met or conversed with a scientist or engineer. In-person public engagement interactions provide opportunities for public audiences to meet and talk with approachable people.

Role models and mentoring play a role in fostering STEM identity and the pursuit of STEM careers. Early interest in a STEM career does not always translate into the pursuit of or retention in a STEM career. However, having a close mentoring relationship with a trusted adult with a similar STEM interest

15 David I. Miller, Kyle M. Nolla, Alice H. Eagly, David H. Uttal (2018) The Development of Children’s Gender-Science Stereotypes: A Meta-analysis of 5 Decades of U.S. Draw-A-Scientist Studies, *Child Development*, November/December 2018, Volume 89, Number 6, Pages 1943-1955. <https://doi.org/10.1111/cdev.13039>

16 Bell, J., Besley, J., Cannady, M., Crowley, K., Grack Nelson, A., Philips, T., Riedinger, K., & Storksdieck, M. (2018). The Role of Identity in STEM Learning and Science Communication: Reflections on Interviews from the Field. Washington, DC: Center for Advancement of Informal Science Education. https://www.informalscience.org/sites/default/files/CAISE%20Identity%20Overview_0.pdf

can play an instrumental role in fostering and retaining an interest in pursuing a STEM career. Near-age peer mentors can also foster feelings of support, connectedness, and belonging.¹⁷

STEM Literacy and Creating Lifelong Learners

STEM literacy is the knowledge and understanding of basic science, technology, and math concepts and processes required for personal decision-making and participation in modern society. Being familiar with basic scientific concepts and processes and having the ability to apply this knowledge in various contexts is thought to be essential to functioning in our modern technology-based economy and civic society.^{18, 19} Given the rapid pace of change in STEM, the need for learning extends well beyond the time spent in K–12 formal education settings.

The world is a complex place, and everyone needs some understanding of STEM to navigate decision-making in their own lives. Public engagement with science can help increase STEM literacy for everyone, not just for those on a pathway to careers in the STEM workforce. Lifelong learning of STEM can help all of us make choices both big and small that can affect our happiness, health, and homes. Substantial evidence indicates that the majority of learning for both children and adults is a result of out-of-school learning opportunities.²⁰



More Trust in Science

Meaningful, thoughtful, and well-implemented public engagement programs have the potential to change attitudes, increase trust, and develop mutual respect between experts and members of the public. The public's

trust in science is linked to their factual knowledge about science and familiarity with scientists as people.²¹ Many different factors affect a person's trust in science as well as the person or institution communicating, including personal values, beliefs, culture, and experiences. More scientific information alone is often not enough to build trust. It is essential to remember that the audience is who decides whether communicators of information and the institutions they represent are trustworthy and credible.²² Meaningful public engagement does have the potential to foster public trust, but it is only one of many factors. For example, recent studies of public views on a variety of science policy issues found that age, gender, race and ethnicity, religious affiliation, educational attainment of science knowledge, and political affiliation all play a role in how an individual judges an issue.²³

17 Stetler, R. L., Kupersmidt, J. B., and Stump, K. M. (2020) Establishing Effective STEM Mentoring Relationships through Mentor Training, *Ann. N.Y. Acad. Sci.* 1483 (2021) 224-243. New York Academy of Sciences. <https://nyaspubs.onlinelibrary.wiley.com/doi/epdf/10.1111/nyas.14470>

18 National Research Council. (1996). *National Science Education Standards*. Washington, DC: National Academy Press. <https://www.nap.edu/catalog/4962/national-science-education-standards>

19 Falk, J. H., Storksdieck, M., and Dierking, L. D. (2007). Investigating public science interest and understanding: Evidence for the importance of free-choice learning. *Public Understanding of Science*, 16(4), 455-469. <https://doi.org/10.1177/0963662506064240>

20 Falk, J.H., Storksdieck, M., Dierking, L.D., Babendure, J., Canzoneri, N., Pattison, S., Meyer, D., Verbeke, M., Coe, M. & Palmquist, S. (2017). The learning SySTEM. In R. Ottinger (Ed.). *STEM ready America*. Flint, MI: Charles Stewart Mott Foundation. <http://stemreadyamerica.org/the-learning-system/>

21 Pew Research Center (2019). Trust and Mistrust in Americans' Views of Scientific Experts, August 2019. <https://www.pewresearch.org/science/2019/08/02/trust-and-mistrust-in-americans-views-of-scientific-experts/>

22 National Academies of Sciences, Engineering, and Medicine. (2017). *Communicating Science Effectively: A Research Agenda*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/23674>

23 Pew Research Center (2015). Americans, Politics and Science Issues, July 2015. <https://www.pewresearch.org/science/2015/07/01/americans-politics-and-science-issues/>

Creating Opportunities for Participatory Democracy

Another aspect of public engagement in STEM is as a form of participatory democracy. As a broader field, STEM experts need to get input and feedback from the public. After all, it is the taxpayers who fund much research and who indirectly as voters set the national research agenda. While science contributes to solving many problems, scientists alone cannot make the decisions or solve the problems. The public will ultimately be affected by new advances in STEM, and in many cases become consumers of new technology. Since these new discoveries and technologies have an impact on society, scientists should take broad perspectives into account when thinking about their own research. Public engagement with science programs can provide a way to gain input and feedback from the public as well as increase the public's capacity to effectively participate in discussions and decision-making.



Understanding Motivations

Understanding experts' motivations to participate in public engagement helps to ensure positive and productive experiences for your institutions, the experts, and public audiences. Tailoring the experience to the needs of all stakeholders will help ensure a successful partnership that is more likely to continue in the future.²⁴

In addition to the potential beneficial impacts of expert engagement with the public described previously, there are some additional motivations museums and other informal education institutions have for working with experts to engage the public.



²⁴ For more on scientists' motivations see:

Portal to the Public (2018). *Portal to the Public Implementation Manual*, Pacific Science Center and Institute for Learning Innovation. <https://popnet.instituteforlearninginnovation.org/resources/>
Storksdieck, M., Stylinski, C., and Canzoneri, N. (2017). *The Impact of Portal to the Public: Creating an Infrastructure for Engaging Scientists in ISL - Summative Evaluation*. Corvallis, OR: Oregon State University.

Experts' Motivations for Public Engagement

An individual expert may hold several or even all of these motivations:

Altruistic:

- Desire to give back to their community
- Inspire and foster interest in young people
- Create a more inclusive and welcoming professional environment

Intrinsic/Personal:

- Genuine enjoyment of interactions; intrinsic joy from connecting with people
- Passion to share knowledge
- Build a culture of interest and excitement about STEM
- Connect and feel like a part of their community

Workplace/Professional:

- Service requirements or incentives
- Encouragement from a membership group or professional society
- Broader impacts funding incentives

Professional Learning:

- Desire to improve their communication skills
- Desire to make their work more relevant to society
- Interest in getting feedback and input from the public
- Opportunity to attract project participants such as for a citizen science project or health study

Institutional Motivations to Partner with Experts in Public Engagement Efforts

Organizational:

- Fulfill institutional mission and goals to achieve impacts (see the Impacts summary earlier in this section)
- Increased authenticity by having more experts involved in programming
- Include expert knowledge and varied perspectives for a project or program
- Build staff professional development about a topic
- Meet project or grant requirements

Community:

- Offer relevant STEM content to the community by connecting with local academic or industry expertise and institutions
- Be seen as a valuable part of the community
- Be seen as a “place for science” and/or a “convener for science policy topics”
- Strengthen relationships with local STEM experts and institutions



SECTION 2

Ways to Work with STEM Experts

Depending on your institution's capacity to find, prepare, and coordinate with a local expert, there are many ways to partner on public engagement programming. In general, it is good practice to start with shorter, simpler engagement formats with the potential to have the working relationship between the institution and the expert grow over time. The level of expert involvement with your institution and the public will of course vary depending on their interest, abilities, and capacity.

Formats for Public Engagement



Special Events

Inviting an expert to participate in a one-time special event is a simple way to get to know an expert and begin to build a relationship. Special events are a good first step since they typically require a short commitment taking place

on one day. Larger special events are also a great opportunity to bring in a local professional society, enthusiast volunteer groups, or

student groups that are interested in public service and direct public engagement. You can find a calendar of STEM-related seasonal events and holidays and related public engagement resources at: <https://www.nisenet.org/seasons>

Hands-On Activities

A great place to begin with experts is to have them facilitate an existing hands-on activity or demonstration. Training with and using popular hands-on activities at your institution will help experts become more familiar with the style of interaction between your educators and public audiences. Many NISE Network hands-on activities

include recommended conversation starters and reflection questions for learners; these prompts help activity facilitators avoid relying on one-way communication while facilitating an activity. Helpful preparation for activity facilitators includes modeling the existing activity in person or with a training video, practicing the activity together with an experienced informal science educator, giving feedback to the facilitator, and preparing them for common questions. Please see the "Tips for Leading Hands-On Activities" tips sheet later in this guide for more helpful suggestions to share with activity facilitators.





Guest Lectures, Talks, and Presentations

Another one-time format is an in-person or virtual guest presentation. This presentation format may be the most familiar and comfortable for many experts. With extra preparation and support, guest presentations can provide a great experience for both the speaker and the audience. Presentation format and content should be tailored for the audience; a presentation to a public audience that includes young children should be quite different from a lecture typically delivered to undergraduates or academic colleagues. There are many other presentation formats for experts to consider that don't involve a stage, such as "Ask Me Anything" Meet-A-Scientist sessions that work well for small-group conversations, tours and field trips, and guided lab tours.

Please see the "Tips for Planning Guest Presentations" tips sheet later in this guide for some suggestions for staff or volunteers coordinating a guest presentation. Also, consider sharing the "Tips for Guest Speakers" tips sheet with new guest speakers presenting at your events.



Science Cafés

Science cafés are casual and welcoming gatherings that encourage conversations and interactions between experts and the public. Science cafés tend to be lively events

and typically often take place in popular locations in the community, like a restaurant, bar, or coffeehouse. This format often includes a short presentation by an expert(s), followed by two-way interactions between the experts and the attendees.²⁵



Forums

The purpose of a public dialogue or forum is to promote conversation about the societal implications of science and technology. Forums create a place for mutual learning on behalf of both the public and experts. Dialogue and deliberation forums usually require a fairly high investment of time for preparation—by participating experts and organizers alike. Sometimes forums may be designed intentionally as a way to gather public feedback and input on a plan or policy.²⁶



Science Festivals

Science festivals are community-based celebrations about science and technology that bring the public into direct contact with hands-on activities, advocacy groups, and experts. Festivals tend to be one-time or annual events, large in scale, and bring together many community organizations and individuals.²⁷

²⁵ Science Café resources: <https://www.sciencecafes.org> and *NISE Network Science Café Guide*: <https://www.nisenet.org/catalog/science-cafe-guide>

²⁶ NISE Network forum resources: <https://www.nisenet.org/forums> and *NISE Network Public Forums Manual*: <https://www.nisenet.org/catalog/public-forums-manual>

²⁷ Science festival resources: <https://sciencefestivals.org>

Virtual Formats

In-person engagement is not always possible due to public health safety guidelines, transportation barriers, time constraints, and geographic distances. In recent years, institutions have become more familiar and skilled at offering virtual engagement programs—creating virtual alternatives to many of the opportunities to involve experts listed above. The major advantage of virtual programs is the increased opportunities for both public audiences and experts to participate in anything from large events to small experiences, with no travel and few expenses. This may provide access for individuals in rural communities or other isolated areas who otherwise might not have a chance to



interact in person with experts. Another advantage is the ability to asynchronously share a virtual program with much larger audiences after an event through recordings. Creative virtual engagement can go beyond a slideshow presentation and include hands-on activities, demonstrations, tours, and meaningful interaction with attendees. Another benefit is having hybrid or blended experiences with experts in different locations—even astronauts!²⁸

Mentoring

Many informal education institutions offer ongoing youth programming through afterschool programs and clubs with sustained long-term interactions with the same youth. Mentoring an individual or small group of youth through an existing program is a great way to develop deeper collaborations with experts. This level of involvement can build lasting, influential relationships that support young people as they explore their passions and discover possible career paths.²⁹

²⁸ For best practices and advice for virtual online engagement, see:

Virtual Programs Featuring Scientists: Scientists, Science Centers, and Public Libraries working together to facilitate high-quality virtual programming for public audiences guide developed by STARnet and Portal to the Public:
https://ncil.spacescience.org/images/papers/Virtual%20Programs%20Featuring%20Scientists_FINAL_small.pdf

Night Sky Network virtual stargazing event resources: https://nightsky.jpl.nasa.gov/download-view.cfm?Doc_ID=669

How to Present Virtually to Students for NASA video: <https://www.youtube.com/watch?v=egSe81sIIDk>

²⁹ For mentoring resources see:

National Mentoring: <https://www.mentoring.org>

STEM Mentoring resources: <https://www.mentoring.org/campaigns/stem-mentoring-month/>

Joint Collaborative Projects

Your institution may want to form a deeper collaboration with a scientist or a research center by pursuing the development and implementation of joint grant proposals and projects. Examples could include jointly creating a citizen science or community science project,³⁰ broader impacts outreach to share ongoing research in the community, a youth workforce development project,³¹ collaborating on the development of hands-on activities or an exhibition, or using the museum as a living laboratory³² for data collection. These types of mutually beneficial partnerships take time and commitment, but can have significant benefits.^{33,34}



30 Cavalier, D., Hoffman, C., and Cooper, C. (2020). *Field Guide to Citizen Science: How You Can Contribute to Scientific Research and Make a Difference*. New York, NY: Workman Publishing. p. 188. <https://www.workman.com/products/the-field-guide-to-citizen-science>

31 Resources for youth programs in museums include:

ASTC (2009) A Handbook for Youth Programs in Science Centers and Museums (retrieved September, 2021) <http://www.astc.org/wp-content/uploads/2014/11/Full-Doc.pdf>

Sneider, C. and M. Burke (2010): The Legacy of YouthAlive! January 28, 2010) (retrieved September, 2021) https://www.informalscience.org/sites/default/files/SneiderandBurke_LegacyofYouthAlive.pdf

New York Hall of Science Science Career Ladder program <https://classic.nysci.org/learninglab/youth-development/science-career-ladder/>

32 Learn more about Living Laboratory research programs and how museums can partner on research studies and serve as locations for scientific studies and data collection: <https://livinglab.org>

33 To learn more about partnering with a research center please see: *A Guide to Building Partnerships Between Science Museums and University-Based Research Centers*: <https://www.nisenet.org/riseguide>

34 For general collaboration advice see: *NISE Network Museum & Community Partnerships: Collaboration Guide* and additional resources: <https://www.nisenet.org/collaboration-guide>



Development Process Content Experts

You may want to involve experts in the development process when creating a new educational program or

exhibition. Consider partnering with relevant content experts at multiple stages of the process, including brainstorming, helping to create content, participating in iterative prototyping, and providing technical content review. Your development work might also include a collaboration and co-creation process with local audiences and scientists. Content experts may be able to provide resources and advice when creating or choosing existing photos, video, and other multimedia—especially scientific imagery.

Professional Development for Staff and Volunteers

Experts may also be an invaluable professional development resource for your institution's staff and volunteers. A common example is offering one or a series of in-person talks or virtual presentations for staff and volunteers about the topic of a traveling museum exhibition. This can be a motivating start to a new initiative or project at your institution.



Liaison Roles

Another valuable role experts can play is acting as a liaison with your institution and their colleagues, students, friends, employers, and membership groups. Examples include alerting undergraduate students looking for community service opportunities, suggesting appropriate specialists who may help you with content review, and connecting you to members of an enthusiasts group. Although these individuals may not be directly interacting with the public themselves, their advice and connections may be invaluable.

Ongoing Advisory Roles

Many informal education institutions seek out experts for ongoing advisory roles that may (or may not) include direct public engagement. Examples of roles can include:

- participating in an ongoing advisory capacity on a project or program
- providing ongoing technical review for draft exhibit signage and program content
- participating on a committee or board
- serving as a competition judge or reviewer on a panel
- helping to answer “Ask a Scientist” questions from local audiences

SECTION 3

How to Prepare Experts to Engage Public Audiences

Specialists are passionate about their subject—that is what makes them an expert!

It is essential to prepare experts for success so that their public engagement efforts are effective and enjoyable for both experts and the public audiences. Effective science communication conveys both complexity and nuance, and does so in a way that is understood by and useful to the audience.

Scientists are often trained to communicate their work with their peers via publications, posters, and presentations that may include research questions, hypotheses, methods, data analysis techniques, and conclusions. While this approach may work for peers within their field, it does not work well for most of the public.

Even if a learner is extremely interested in the STEM topic, most people are easily overwhelmed by the depth of content and jargon that characterize most professional presentations. Experts need to meet the public where they are to connect in a meaningful way. This means being aware of their audiences' experience level, needs, interests, and potential reactions.



NISE Network Strategies and Guides for STEM Engagement Design and Implementation

The NISE Network has created a series of professional learning guides for the design and implementation of STEM engagement materials based on the following strategies.³⁵

Program Design

- Design programs to be relevant, effective, and foster conversations³⁶
- Incorporate societal and ethical implications of science and technology³⁷

Community Collaboration

- Collaborate locally with youth-serving community organizations to reach diverse audiences³⁸

Finding and Preparing Experts

- Work with professional associations, higher-education institutions, and other networks to find and prepare experts for engaging with local audiences
- When possible, work with minority-serving professional associations to seek experts with diverse backgrounds
- When possible, seek college and graduate students who may be closer in age to children and youth participating in a program

Inclusion and Relevance

- Employ Diversity, Equity, Accessibility, and Inclusion (DEAI) practices in program design and structure³⁹

Go beyond Public Understanding of Science (PUS) to Public Engagement with Science (PES)

- Design public engagement to create two-way conversations among publics and scientists for mutual learning⁴⁰



35 NISE Network professional learning resources for educators <https://www.nisenet.org/educators> and for scientists: <https://www.nisenet.org/scientists>

36 NISE Network Program Development: A NISE Network Guide to Creating Effective Learning Experiences for Public Audiences: <https://www.nisenet.org/catalog/nise-network-program-development-guide>

37 NISE Network Nanotechnology and Society Guide: A Practical Guide to Engaging Museum Visitors in Conversations: <https://www.nisenet.org/catalog/nanotechnology-and-society-guide>

38 NISE Network Museum & Community Partnerships: Collaboration Guide and additional resources: <https://www.nisenet.org/collaboration-guide>

39 For more Diversity, Equity, Accessibility, and Inclusion (DEAI) resources please see: NISE Network Inclusive Audiences: <https://www.nisenet.org/audiences>

40 Public Engagement with Science: A guide to creating conversations among publics and scientists for mutual learning and societal decision-making: <https://www.nisenet.org/public-engagement-conversations-guide>

Prepare Experts to Facilitate Hands-On Activities at an Event

Before the event

- Provide logistical details in advance
- Be clear about their role and type of experience you're seeking
- If you have a training video or written materials about an activity, you could share them before the event

Host a short orientation training before or on the same day of the event

- If possible, provide beverages or snacks
- Provide a short orientation (event purpose and goals, audience background and expectations, facility, event logistics)
- Model an existing activity (in-person or with a training video)
- Give new facilitators the opportunity to practice the activity
- Give facilitators constructive feedback and ask questions
- Provide suggestions for how to respond to common questions

After the event

- Follow up with experts, thank them, and ask for their feedback

Please see the Tips Sheet section

- “Tips for Planning Guest Presentations” for museum staff and volunteers
- “Tips for Guest Speakers” for presenters
- “Tips for Leading Hands-On Activities” designed for facilitators

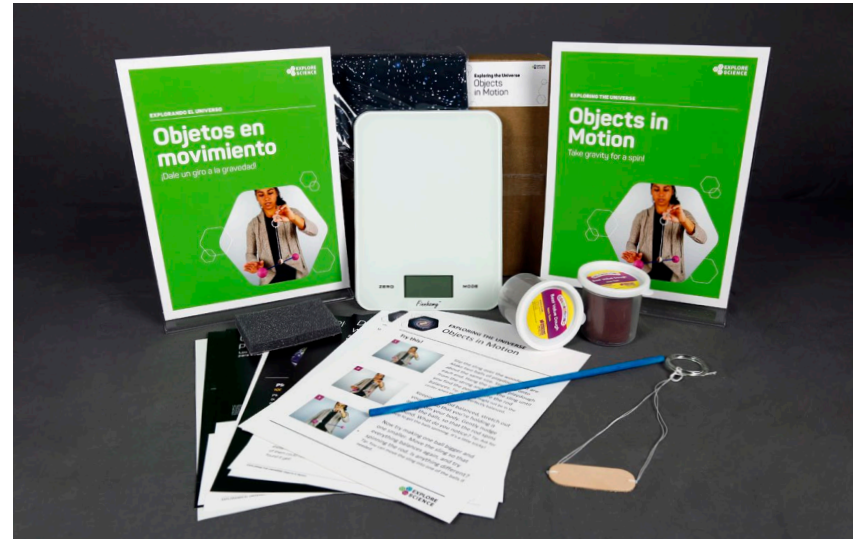


NISE Network kits and activities typically include orientation materials including staff and volunteer training slides, tips sheets, facilitator guides, and facilitation training videos. Training videos are designed to show facilitation strategies for specific hands-on activities, share specific activity content and background information, and model best practices in public engagement.

Training Materials for NISE Network Hands-On Activities

Training materials include orientation presentations, facilitator guides, and videos:

- All digital kits:
<https://www.nisenet.org/kits>
- Explore Science: Earth & Space toolkits (2017–2020):
<https://www.nisenet.org/earthspacekit>
- Explore Science: Let's Do Chemistry kit (2018):
<https://www.nisenet.org/chemistry-kit>
- Frankenstein200 kit (2018):
<https://www.nisenet.org/frankensteinkit>
- Building with Biology kit (2016):
<https://www.nisenet.org/building-with-biology-kit>
- Sustainable Futures (2020):
<https://www.nisenet.org/sustainable-futures>
- SustainABLE kit (2016):
<https://www.nisenet.org/sustainable-kit>
- Museum & Community Partnerships Explore Science: Zoom into Nano kit (2016):
<https://www.nisenet.org/explorescience-nano>
- NanoDays (2009–2015):
<https://www.nisenet.org/nanodays>



NISE Network Training Videos

All training videos:

- NISE Network Training videos for NISE Network educational products can be found at:
<https://www.nisenet.org/pd/training-videos>
- Videos are hosted on the NISE Network Vimeo Channel:
<https://vimeo.com/nisenet>

General facilitation skills videos include:

- Speed-ucate Video or How to Have an Effective Science and Society Conversation:
<https://www.nisenet.org/catalog/speed-ucate-video>
- Edu-Cathalon: A facilitation strategies and best practices training video for engaging museum visitors in STEM-related content:
<https://www.nisenet.org/catalog/educathalon-facilitation-strategies>
- America's Next Top Presenter:
<https://www.nisenet.org/catalog/americas-next-top-presenter>
- Chem-Attitudes with Dr. Braxton Hazelby facilitation training video:
<https://www.nisenet.org/catalog/chem-attitudes-dr-braxton-hazelby-facilitation>
- More training videos available at:
<https://www.nisenet.org/pd/training-videos>

Hands-on activity training videos for individual activities include:

- Explore Science: Earth & Space video collection:
<https://vimeopro.com/nisenet/explore-science-earth-space>
- Explore Science: Let's Do Chemistry video collection:
<https://vimeopro.com/nisenet/explore-science-lets-do-chemistry-training-films>
- Frankenstein200 video collection:
<https://vimeopro.com/nisenet/frankenstein200-activity-training-videos>
- Building with Biology video collection:
<https://vimeopro.com/nisenet/buildingwithbiology>
- Sustainability video collection:
<https://vimeopro.com/nisenet/sustainability>
- Explore Science: Zoom into Nano video collection:
<https://vimeopro.com/nisenet/exploresciencezoomintonano>
- NanoDays video collection:
<https://vimeopro.com/nisenet/nanodays-training-videos>



NISE Network Science Communication Tools for Scientists

The NISE Network has created a wide variety of professional development tools, guides, workshops, and training materials as resources designed for educators and scientists to improve their capacity to engage the public in current science and technology.

- Compilation of NISE Network resources for scientists:
<https://www.nisenet.org/scientists>
- Professional learning resources:
<https://www.nisenet.org/pd>
- Tips Sheets for Engaging Public Audiences: A collection of tips sheets for engaging public audiences in hands-on STEM activities. Specific sheets are available for girls, young learners, bilingual audiences, preparing guest speakers, creating conversations, difficult concepts, and accessibility and inclusion:
<https://www.nisenet.org/catalog/tips-sheets-engaging-public-audiences>
- Sharing Science Workshop & Practicum Planning & Implementation Guide designed for early career scientists:
https://www.nisenet.org/catalog/tools_guides/sharing_science_workshop_practicum
- Research Experiences for Undergraduates (REU) Science Communication Workshop Planning & Implementation Guide:
<https://www.nisenet.org/catalog/reu-science-communication-workshop>



Annotated List of Resources

Science Communication

Science communication (SciComm) is the practice of information, educating, and raising awareness about science with the public.

AAAS Communicating Science

AAAS Center for Public Engagement with Science & Technology offers workshops and seminars for scientists and engineers who wish to develop their public engagement and science communication skills, enabling them to establish meaningful dialogue with diverse audiences.

<https://www.aaas.org/programs/communicating-science>

Alan Alda Center for Communicating Science

Alda Center programs empower researchers to build an authentic rapport that can help others appreciate the wonder and value of science. Resources include workshops and training.

<https://aldacenter.org>

American Society for Biochemistry and Molecular Biology (ASBMB)

ASBMB offers an eight-week online “Art of Science Communication” course open to all scientists.

<https://www.asbmb.org/career-resources/communication-course>

Portal to the Public

Portal to the Public Network (PoPNet) helps informal learning organizations utilize and train scientists and engineers to have meaningful conversations with publics around local STEM issues. The Portal to the Public Implementation Manual and Catalog of

Professional Development Elements is a comprehensive, practical resource for organizations planning to connect scientists and public audiences through conversations and activities.

<https://popnet.instituteforlearninginnovation.org>

Science Public Engagement Partnership (SciPEP)

Sponsored by the U.S. Department of Energy’s Office of Science and The Kavli Foundation, Science Public Engagement Partnership (SciPEP) seeks to ensure scientists are supported to be effective communicators and, if appropriate, active in engaging the public. SciPEP recognizes the role communication and engagement professionals play in supporting science and scientists’ engagement efforts.

<https://scipep.org>

Science Festival Alliance

Science Festival Alliance offers resources and tools to the professional community to support and enhance science and technology festivals.

<https://sciencefestivals.org>

SENCER—Science Education for New Civic Engagements and Responsibilities

SENCER courses and programs strengthen student learning and interest in science, technology, engineering, and mathematics by connecting course topics to issues of critical local, national, and global importance. Students and faculty report that the SENCER approach makes science more real, accessible, and civically important.

<http://sencer.net>

Broadening Participation

Broadening participation in STEM aims to engage and build the capacity of all people in STEM learning and training, particularly those traditionally underrepresented in STEM fields.

CAISE Broadening Perspectives on Broadening Participation in STEM Toolkit

This toolkit by the Center for Advancement of Informal Science Education was designed to support science engagement professionals working on broadening participation, and provides resources to plan and lead discussions about current practices to make ISE and science communication work more inclusive.

<https://www.informalscience.org/broadening-perspectives>

Community Science Projects

Community science is an emerging practice for the science and technology center and museum field aimed at nurturing relationships between science and communities. This community-centered approach aims to advance lifelong science learning, connect science and society, engage diverse audiences, and partner to solve local and global challenges.

<https://www.astc.org/impact-initiatives/astcs-community-science-initiative/>

IF/THEN®

The IF/THEN® initiative is designed to shift cultural perceptions of who works in STEM and open young girls' eyes to the possibility of STEM careers. Resources include the This Is What A Scientist Looks Like™ campaign, AAAS Ambassadors, and a collection of royalty-free images.

<https://www.ifthenshecan.org>

Inclusive SciComm

Inclusive science communication seeks to shift the traditional paradigm of science communication toward an approach that centers on inclusion, equity, and intersectionality. The website includes resources and publications.

<https://inclusivesciComm.org/resources/>

National Girls Collaborative Project (NGCP)

NGCP brings together organizations in the U.S. committed to informing and encouraging girls to pursue careers in STEM. Resources include webinars, publications, and exemplary practices.

<https://ngcproject.org>

Project READY: Reimagining Equity & Access for Diverse Youth

Project READY professional development materials focus on improving relationships with, services to, and resources for youth of color and Native youth. Professional development modules assist librarians and educators interested in improving their knowledge about race and racism, racial equity, and culturally sustaining pedagogy.

<https://ready.web.unc.edu/>

The Smithsonian's National Museum of African American Culture and History

Talking About Race provides resources and tools for educators and others to establish conversations about race.

<https://nmaahc.si.edu/learn/talking-about-race>

YESTEM Project

The YESTEM project has tools and resources focusing on equity, access, opportunities, and pathways in STEM. The website includes videos, publications, and the Equity Compass tool.

<https://yestem.org/tools/>

Techbridge Role Models Matter Toolkit

This resource prepares STEM professionals to do outreach with girls and underrepresented youth. It includes practical tips, hands-on STEM activities, and reflection exercises.

<https://www.techbridgegirls.org/rolemodelsmatter/>

Broader Impacts

Broader impacts refers to the potential of research to not only advance knowledge but to benefit society. The benefits can involve broadening participation in STEM, tackling societal challenges, and advancing the public understanding of science.

Advancing Research Impact in Society (ARIS)

ARIS, formerly National Alliance for Broader Impacts (NABI), offers broader impacts resources including “Broader Impacts 101” training webinars for resources and more in-depth tools and resources.

<https://www.researchinsociety.org>

CAISE Informal STEM Education: Resources for Outreach, Engagement and Broader Impacts

This report by the Center for Advancement of Informal Science Education provides an overview of engagement and public participation in scientific research and synergies with science communication. The report includes a short list of organizations and networks that have resources and infrastructure to support broader impacts.

<https://www.informalscience.org/informal-stem-education-resources-outreach-engagement-and-broader-impacts>

Additional Useful Resources

Center for Advancement of Informal Science Education (CAISE)

The Center for Advancement of Informal Science Education’s InformalScience.org website hosts a collection of project, research, and evaluation resources designed to support the informal STEM education community in a variety of learning environments.

<https://www.informalscience.org>

COMPASS

COMPASS focuses on preparing scientists to become agents of change in the areas of equitable solutions to climate change and biodiversity loss. Their resources include publications, workshops, and training.

<https://www.compassccomm.org/tools-resources/>

Civics Science Fellows

The Civics Science Fellows program is designed to support a cohort of fellows in collaborations that allow science and research to more meaningfully connect with diverse communities and our shared civic life. The website includes a collection of civic science research and practice resources.

<https://civicsciencefellows.org/resources/>

FrameWorks Institute

The FrameWorks Institute is a nonprofit research organization that helps mission-driven organizations build public will for progressive change. The institute applies rigorous social science methods to study how people understand social issues and develop evidence-based techniques to explain those issues more effectively.

<https://www.frameworksinstitute.org>

National Living Lab Initiative

In the Living Laboratory's educational model, scientists (in disciplines including developmental psychology, cognitive science, educational psychology, cognitive neuroscience, social psychology, and related fields) recruit participants and conduct their studies at museums, rather than behind closed doors. Families visiting the museum are invited to participate in ongoing research projects (on topics including math and language cognition, causal learning, emotion recognition, and social reasoning), and to engage in one-on-one conversations with the scientists.

<https://livinglab.org/>

Story Collider

Known for their podcast, Story Collider is a nonprofit organization dedicated to making science personal through true, first-person storytelling. Narratives tend to be successful in generating interest and engagement with a topic, improving comprehension, and influencing real-world beliefs. They offer training and storytelling workshops.

<https://www.storycollider.org>

STEM Ambassador Program

The STEM Ambassador Program (STEMAP) offers a public engagement training program for scientists to build science communication skills, build relationships, and design engagement projects.

<https://stemap.org>

Conferences and Initiatives

Many professional scientific societies have outreach, education, and science communication sessions within their conferences. The following are a few of the many conferences and initiatives that focus on public engagement with science:

- Association of Science and Technology Centers:
<https://www.astc.org>
- Inclusive SciComm Symposium:
<https://inclusivesciComm.org>
- SciPEP:
<https://scipep.org>
- Science Talk:
<https://www.sciencetalk.org>



SECTION 4

Tips Sheets

The NISE Network has developed a collection of Tips Sheets for engaging public audiences in hands-on STEM activities. Tips sheets cover a range of specific topics, including engaging girls and young learners in STEM, bilingual audiences, preparing guest speakers, creating conversations, difficult concepts, and accessibility and inclusion.

The content for several of the tips sheets has been included in this guide. Additional tips sheets are available for download:
<https://www.nisenet.org/catalog/tips-sheets-engaging-public-audiences>

Tips for Leading Hands-On Activities

Greet your guests

Say “hello,” make eye contact, and smile. People will come over if you look welcoming, available, and friendly. As much as possible, let your guests do the hands-on parts of the activity, and let them discover what happens. (If your activity has a surprise, don’t give it away!)

Encourage exploration

Provide positive feedback and assistance when people need it, but let them experiment and learn for themselves. Don’t insist people do things the “right” way—sometimes learning how something doesn’t work is just as valuable as learning how it does work.

Ask open-ended questions

Help people observe and think about the activity. Try to use questions that have more than one answer, such as: “What do you see happening?”, “Why do you think that happened?”, “What surprised you about what you saw?”, and “Does this remind you of anything you’ve seen before?”

Be a good listener

Be interested in what your guests tell you, and let their curiosity and responses drive your conversation forward.

Share what you know

Use clear, simple language. Focus on one main idea—you don’t need to explain everything at once! Start with very basic information, and then share more with interested learners.

Use examples from everyday life

Familiar examples can help explain abstract concepts. Be aware of different abilities, keeping in mind that children do not have the same skills or vocabulary as adults.

Offer positive responses

If people haven’t quite grasped a concept, you might say, “That’s a good guess!” or, “Very close, any other ideas?” Don’t say, “No” or “Wrong.” You can offer hints or suggestions for things to think about or watch carefully.

Share accurate information

If you aren’t sure about something, it’s OK to say, “I don’t know. That’s a great question!” Suggest ways that people can learn more, either by trying another activity or looking up information at the library or online.

Remain positive

Maintain an inviting facial expression, positive tone, and open body language throughout the interaction.

Thank your guests

As your interaction ends, suggest other activities that you think your guests might enjoy.

Have fun!

A positive experience will encourage learning.



www.nisenet.org

Tips for Planning Guest Presentations

Expert speakers can be a wonderful addition to your event. With extra preparation and support, guest presentations can provide a great experience for both the speaker and the audience. Here are some suggestions to help make things go smoothly:

- When inviting scientists to participate, be clear about their role and the type of experience you are seeking.
- Familiarize invited guest speakers with your expected audience, including anticipated ages, level of background knowledge, or any other demographics that may help them tailor their talk.
- Let speakers know about any expectations you may have related to audience involvement.
- Discuss the content and length of the planned presentation.
- Share the "Tips for Guest Speakers" sheet with your presenter; you might also share some of the other training materials.
- Encourage your invited speaker to use plain language, avoiding jargon and technical terms.
- Discuss details about your facility, including room size, seating style, and audio-visual equipment.
- Ask to review a draft slideshow or notes in advance and discuss the planned presentation together.
- Schedule time before the presentation to work out any audio-visual or logistical issues.
- Prepare questions that may help stimulate audience discussion.

Tips for Guest Speakers

Public audiences find emerging science and technology interesting. Keep in mind, however, that only a small percentage of the population knows much about this topic. Here are a few pointers for communicating with the public about science, engineering, and technology.

Know your audience

The more you know about your audience, the better you can adapt your presentation to their interests. Keep in mind the diversity of your audience's experience and backgrounds. Many visitors attend in family groups, which can include a wide range of ages and abilities. Also keep in mind that there are many "publics" rather than one monolithic general public.

Keep the message simple

Come up with one "big idea" you want the audience to take away from the experience, and make sure your presentation reiterates and reinforces this idea in different ways. Define your terms, avoiding jargon and acronyms as much as possible. Check in with your audience periodically to see if they're following you.

Use familiar analogies

Use comparisons to everyday experiences. Explain how the topic relates to something that's been in the news or in popular culture.

Use relative size and scale

Focus on relative size and scale rather than exact measurements. Consider using parts of the human body to explain relative scale.

Use visuals

Simple images and models will reinforce and clarify your message.

Use several modes of presentation

In addition to talking, you can include demonstrations, videos, and pictures. You can involve the audience by providing objects to pass around, asking questions, doing brief experiments, providing hands-on activities, and playing games.

Involve the audience in the processes of science

Encourage your audience to observe, predict, and explore by asking them questions: "What do you think will happen when . . . ?" "Were you surprised?" "Why do you think that happened?" "What if you tried . . . ?" "Can you think of any practical uses for this?" "What about unintended consequences?"

Be friendly and approachable

Remember to make eye contact, smile, and let the audience know who you are. If you're a scientist, consider including personal stories about your work life and your career decisions.

Be prepared to answer common questions

But don't be afraid to let your audience know if you don't know the answer to their question.

Share ways to learn more

Remember that your presentation is only one exposure that people will have to this topic—it's not the end of their learning. Help the audience connect to other opportunities for more exploration.

Tips for Planning Guest Presentations

Expert speakers can be a wonderful addition to your event. With extra preparation and support, guest presentations can provide a great experience for both the speaker and the audience. Here are some suggestions to help make things go smoothly:

- When inviting scientists to participate, be clear about their role and the type of experience you are seeking.
- Familiarize invited guest speakers with your expected audience, including anticipated ages, level of background knowledge, or any other demographics that may help them tailor their talk.
- Let speakers know about any expectations you may have related to audience involvement.
- Discuss the content and length of the planned presentation.
- Share the “Tips for Guest Speakers” sheet with your presenter; you might also share some of the other training materials.
- Encourage your invited speaker to use plain language, avoiding jargon and technical terms.
- Discuss details about your facility, including room size, seating style, and audio-visual equipment.
- Ask to review a draft slideshow or notes in advance and discuss the planned presentation together.
- Schedule time before the presentation to work out any audio-visual or logistical issues.
- Prepare questions that may help stimulate audience discussion.



Tips for Guest Speakers

Public audiences find emerging science and technology interesting. Keep in mind, however, that only a small percentage of the population knows much about this topic. Here are a few pointers for communicating with the public about science, engineering, and technology.

Know your audience

The more you know about your audience, the better you can adapt your presentation to their interests. Keep in mind the diversity of your audience's experience and backgrounds. Many visitors attend in family groups, which can include a wide range of ages and abilities. Also keep in mind that there are many "publics" rather than one monolithic general public.

Keep the message simple

Come up with one "big idea" you want the audience to take away from the experience, and make sure your presentation reiterates and reinforces this idea in different ways. Define your terms, avoiding jargon and acronyms as much as possible. Check in with your audience periodically to see if they're following you.

Use familiar analogies

Use comparisons to everyday experiences. Explain how the topic relates to something that's been in the news or in popular culture.

Use relative size and scale

Focus on relative size and scale rather than exact measurements. Consider using parts of the human body to explain relative scale.

Use visuals

Simple images and models will reinforce and clarify your message.

Use several modes of presentation

In addition to talking, you can include demonstrations, videos, and pictures. You can involve the audience by providing objects to pass around, asking questions, doing brief experiments, providing hands-on activities, and playing games.

Involve the audience in the processes of science

Encourage your audience to observe, predict, and explore by asking them questions: "What do you think will happen when . . . ?" "Were you surprised?" "Why do you think that happened?" "What if you tried . . . ?" "Can you think of any practical uses for this?" "What about unintended consequences?"

Be friendly and approachable

Remember to make eye contact, smile, and let the audience know who you are. If you're a scientist, consider including personal stories about your work life and your career decisions.

Be prepared to answer common questions

But don't be afraid to let your audience know if you don't know the answer to their question.

Share ways to learn more

Remember that your presentation is only one exposure that people will have to this topic—it's not the end of their learning. Help the audience connect to other opportunities for more exploration.

Tips for Leading Hands-On Activities

Greet your guests

Say “hello,” make eye contact, and smile. People will come over if you look welcoming, available, and friendly. As much as possible, let your guests do the hands-on parts of the activity, and let them discover what happens. (If your activity has a surprise, don’t give it away!)

Encourage exploration

Provide positive feedback and assistance when people need it, but let them experiment and learn for themselves. Don’t insist people do things the “right” way—sometimes learning how something doesn’t work is just as valuable as learning how it does work.

Ask open-ended questions

Help people observe and think about the activity. Try to use questions that have more than one answer, such as: “What do you see happening?”, “Why do you think that happened?”, “What surprised you about what you saw?”, and “Does this remind you of anything you’ve seen before?”

Be a good listener

Be interested in what your guests tell you, and let their curiosity and responses drive your conversation forward.

Share what you know

Use clear, simple language. Focus on one main idea—you don’t need to explain everything at once! Start with very basic information, and then share more with interested learners.

Use examples from everyday life

Familiar examples can help explain abstract concepts. Be aware of different abilities, keeping in mind that children do not have the same skills or vocabulary as adults.

Offer positive responses

If people haven’t quite grasped a concept, you might say, “That’s a good guess!” or, “Very close, any other ideas?” Don’t say, “No” or “Wrong.” You can offer hints or suggestions for things to think about or watch carefully.

Share accurate information

If you aren’t sure about something, it’s OK to say, “I don’t know. That’s a great question!” Suggest ways that people can learn more, either by trying another activity or looking up information at the library or online.

Remain positive

Maintain an inviting facial expression, positive tone, and open body language throughout the interaction.

Thank your guests

As your interaction ends, suggest other activities that you think your guests might enjoy.

Have fun!

A positive experience will encourage learning.



SECTION 5

Strategies for Finding STEM Experts

The NISE Network strongly encourages institutions to collaborate with local experts. Partnering with experts is a key ingredient to many successful public engagement efforts. It is up to your institution to select how and when you would like to involve experts.

One of the best ways to find experts is to seek people and organizations in your community that are already involved in and committed to a STEM topic. Volunteers may offer their expertise and time, and some of them may have their own educational activities and information that are appropriate for your program.

Strategies for Finding STEM Experts

- Identify experts you might like to work with and begin to build and grow your relationship over time
- Work with professional associations, higher-education institutions, and other networks to help you find and prepare experts to engage with local audiences
- Work with minority-serving professional associations to seek experts with diverse backgrounds
- Consider seeking college and graduate students who may be closer in age to children and youth participating in a program



Where to Find Local STEM Experts

Colleges and Universities

Community colleges, four-year colleges, and universities typically have a wide variety of STEM experts who are interested in reaching local audiences. Once you connect with a faculty or staff member, they can usually suggest undergraduate and graduate students who may be able to volunteer at your event or program. Also be sure to look into outreach offices at the local college that may coordinate volunteers and be aware of service requirements. Outreach programs may also be able to steer you in the direction of specific faculty, staff, and student groups that would be helpful in your search.

When seeking partnerships with individuals and groups at community colleges, four-year colleges, and universities, don't forget there are experts at Minority Serving Institutions (MSI) of higher education. Some of these colleges and universities are located in remote regions of the country, whereas others serve urban neighborhoods. Some are only a few decades old, whereas others have been striving for more than a century to give their constituents the social and educational skills needed to overcome racial discrimination and limited economic opportunities:

- Historically Black Colleges and Universities (HBCUs) map and list: <https://hbcufirst.com/resources/hbcu-list-map>
- Hispanic-Serving Institutions (HSIs) map and list from the Hispanic Association of Colleges and Universities (HACU): <https://www.hacu.net/hacu/HSIs.asp>

- Tribal Colleges and Universities (TCUs) map and list from the American Indian Higher Education Consortium (AIHEC): <http://www.aihec.org/who-we-serve/TCUmap.cfm>
- Asian American and Native American Pacific Islander Serving Institutions (AANAPISIs): <https://apiascholars.org/aanapisi-new/>

Depending upon the STEM topic, Cooperative Extension programs can be a great resource since they are dedicated to outreach. Many land grant colleges and universities are also home to Cooperative Extension offices with local experts on various topics, including agriculture, natural resources, 4-H youth development, family and consumer science, food, gardening, and many environmental topics:

- Map and list of land grant colleges: <https://nifa.usda.gov/land-grant-colleges-and-universities-partner-website-directory>
- Most counties within the U.S. have a Cooperative Extension office that may include many types of expertise including agriculture services, gardening advice, and insect identification: <https://www.gardeningknowhow.com/extension-search>

Student Groups

Graduate, undergraduate, and high school student groups can be wonderful additions to your STEM programming. Because they are closer in age to children and youth who may be participating in your programs, these student experts may be more approachable for your family and general audiences.



Colleges often have student groups associated with professional societies (such as the Society for Women Engineers) or affinity groups connected with STEM topics (such as environmental or astronomy

clubs). Undergraduate and graduate students can be great partners, but inevitable turnover with student membership and leadership in these organizations can make working with them in the long-term a challenge. Developing a relationship with the group's faculty or staff adviser can help smooth out annual student transitions. It also helps to be aware of school holidays and exam periods before requesting participation at events. Offering regular and predictable ways these groups can interact with your institution will go a long way in developing your student partnerships.

STEM Professional Societies

Many STEM professional societies have regional chapters, sections, or groups that can help direct you to local experts in your geographic region. These local chapters are often associated with colleges and universities.⁴¹ Many STEM professional societies encourage their members to participate in local outreach and public engagement activities. In the next section of this guide, we provide examples of professional societies with regional chapters or searchable outreach databases.



Diversity-Serving Professional Societies

When possible, work with minority-serving professional associations to seek experts with diverse backgrounds. Connecting with STEM professionals from different ethnic and demographic backgrounds gives public audiences the opportunity to see and meet experts who might look more like themselves. Members of these societies tend to be passionate about public engagement and some have local or regional chapters:

- AAAS IF/THEN® Ambassadors:
<https://www.aaas.org/page/ifthen-ambassadors>
- American Indian Science and Engineering Society:
<https://www.aises.org>
- National Action Council for Minorities in Engineering:
<https://www.nacme.org>
- MAES – Latinos in Science and Engineering:
<http://mymaes.org>
- National Society of Black Engineers (NSBE):
<https://www.nsbe.org>
- National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE):
<https://www.nobcche.org/chapters>
- National Organization of Gay and Lesbian Scientists and Technical Professionals:
<https://www.noglstp.org>
- Society of Asian Scientists and Engineers:
<https://saseconnect.org>

41. There are hundreds of professional scientific societies in the US, a list affiliated with the American Association for the Advancement of Science (AAAS) can be found at: <https://www.aaas.org/group/60/list-aaas-affiliates>

- Society of Hispanic Professional Engineers:
<https://www.shpe.org>
- Society of Nonbinary Scientists:
<https://isnbs.org/>
- Society of Women Engineers (SWE):
<https://swe.org/membership/sections/>
- Society for Advancement of Chicanos and Native Americans in Science (SACNAS):
<https://www.sacnas.org>

Local, State, and Federal Agencies

Local, state, and federal agency staff have a great deal of knowledge to share on a variety of STEM topics, including engineering, environmental management, water quality, waste management, land conservation, public health, transportation, Earth and space science, and much more. Additionally, keep in mind that many local agency staff can be very eager to make direct connections with local residents.



Local Industry Professionals

You may have experts from local industry in your area. Many corporations with employee volunteer programs seek opportunities to contribute to the well-being of their local

communities and connect their employees with community members. Featuring local employers is a great way to make potential workforce development connections.

Affinity Groups

Enthusiasts, interest groups, and organizations with STEM connections often have members who are excited to share their passions.

Examples of these groups can include avid gardeners, birders, amateur radio societies, and astronomy clubs. Some of these local clubs and groups may be part of larger organizations and umbrella networks such as birding clubs that are affiliated with the National Audubon Society and astronomy clubs that are part of the Night Sky Network.



Indigenous Ways of Knowing

Seeking out and connecting with local Indigenous community leaders who have local knowledge and perspectives to share for a long-term relationship is the first step toward co-creating relevant educational materials or programs. Like all relationships, building trust with new partners takes time, and working with Tribal Nations is different from working with the majority culture.



If your institution is committed to a long-term relationship, you may want to explore the “Two-Eyed Seeing” approach increasingly being used to braid together Western methods and theories with Indigenous knowledge. Two-Eyed Seeing is “learning to see from one eye with the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strengths of mainstream



knowledges and ways of knowing, and to use both these eyes together, for the benefit of all.”⁴²

Unlike many other STEM experts with full-time paid positions,

Indigenous elders, leaders, and storytellers may need honorariums or stipends to compensate for their time and the expertise they share.

Below are some suggested resources to guide you on the journey to building relationships with Indigenous communities.

Connect with Indigenous people in your area:

- **Native Land Digital** strives to create and foster conversations about the history of colonialism, Indigenous ways of knowing, and settler-Indigenous relations through educational resources such as our map and Territory Acknowledgement Guide. Once you click on a region of the Native Land map, a number of links will appear with different nation names. By clicking on those links, you will be taken to a page specifically about that nation, language, or treaty, and where you can learn more:

<https://native-land.ca/>

- **National Congress of American Indians (NCAI)**

There are 574 federally recognized Indian Nations (variously called tribes, nations, bands, pueblos, communities, and native villages) in the U.S. Approximately 229 of these ethnically, culturally, and linguistically diverse nations are located in Alaska; the other federally recognized tribes are located in 35 other states.

Additionally, there are tribes located throughout the U.S. that are recognized by their respective state governments:

<https://www.ncai.org/tribal-directory>

- **Bureau of Indian Affairs** lists of federally recognized tribes: <https://www.bia.gov/regional-offices>
- Many **Tribal Nations** have their own education and cultural departments that can offer insights on how to work with their people.
- **State land grant university** and **Cooperative Extension** offices may have extension agents assigned specifically to Tribal Nations.

Connect with the local Indian Health Service (IHS) office, especially for health-related STEM topics:

- The Indian Health Service is divided into twelve geographic areas of the U.S. Each area has a unique group of tribes they work with on a day-to-day basis. Each IHS geographic area includes a list and links to the tribes and nations the agency serves. To learn more about each of these areas, their facilities, and culture, select from the map or choose an area from the list on this page:

<https://www.ihs.gov/locations/>

Connect with members of STEM professional societies:

- The American Indian Science and Engineering Society (AISES) is a national nonprofit organization focused on substantially increasing the representation of Indigenous peoples of North America and the Pacific Islands in science, technology, engineering, and math (STEM) studies and careers.

<https://www.aises.org/>

⁴² Bartlett, C., Marshall, M., & Marshall, A. (2012). Two-eyed seeing and other lessons learned within a co-learning journey of bringing together Indigenous and mainstream knowledges and ways of knowing. *Journal of Environmental Studies and Sciences*, 2(4), 331–340. <https://doi.org/10.1007/s13412-012-0086-8>

- Society for Advancement of Chicanos and Native Americans in Science (SACNAS) is an inclusive organization dedicated to fostering the success of Chicanos/Hispanics and Native Americans, from college students to professionals, in attaining advanced degrees, careers, and positions of leadership in STEM.

<https://www.sacnas.org>

Additional Resources:

- The Indigenous Education Institute (IEI) was created for the preservation and contemporary application of traditional Indigenous knowledge.
<http://indigenouseducation.org>
- Native Skywatchers Two-Eyed Seeing resources
<https://www.nativeskywatchers.com/index.html>
<https://www.nativeskywatchers.com/two-eyed-seeing-nasa.html>
- Institute for Integrative Science & Health Two-Eyed Seeing resources
<http://www.integrativescience.ca/Principles/TwoEyedSeeing/>

Learn more about relationship building with Indigenous communities:

- Relationships First and Always: A Guide to Collaborations with Indigenous Communities (2020)
<https://www.hou.usra.edu/meetings/lpsc2021/pdf/2657.pdf>
- Teaching Through the Four Rs of Indigenous Education: Respect, Relevance, Reciprocity, and Responsibility
<https://learningbird.com/teaching-through-the-four-rs-of-indigenous-education-respect-relevance-reciprocity-and-responsibility/>

Arts and Cultural Connections

STEM experts can also be included as part of arts and cultural events that your institution may celebrate. These events are a great way to provide opportunities for learners to express their creativity, tell a local story, and make STEM content more relevant for your public audiences. Celebrating cultural events is a great way to involve experts, celebrate accomplishments, share stories of historical and living people, and make STEM content more relevant. Additionally, some STEM topics, such as astronomy, provide an opportunity to include a rich cultural history from all over the world and are a way to connect and resonate with public audiences.^{43,44}



Societal and Policy Experts

Museums and similar informal learning institutions can inform people about science and technology, but they also have the power to engage their public audiences to reflect on how aspects of STEM may affect their lives and society as a whole. Three big ideas that can provide us with a framework for conversations about technology and society are: 1) Values: values shape how technologies are both developed and adopted, 2) Relationships: technologies affect social relationships, and 3) Systems: technologies work because they are

⁴³ For astronomy examples see: Andrew Fraknoi (2020) The Astronomy of Many Cultures: A Resource Guide, Fromm Institute, U. of San Francisco, Version 5.1; July 2020.
https://astrosociety.org/file_download/inline/eb3601be-8e70-4f11-8e12-3c8c5b52e66a

⁴⁴ For example, Guerilla Science aims to change how people connect with science so that science is celebrated as an intrinsic part of human culture: <https://guerillascience.org>



part of larger systems.⁴⁵ Consider seeking experts that can help make these societal connections and make STEM topics more relevant for your audiences. Sources of expertise can be found in local public health agencies, local governmental planning agencies, and university extension programs. There are academic programs and professional societies focused specifically on the study of science, technology, and society (STS).⁴⁶ Additionally, many STEM professional societies have special-interest groups or sections that focus on societal, ethical, legal, and policy implications of their discipline.

⁴⁵ Learn more: NISE Network *Nanotechnology and Society Guide: A Practical Guide to Engaging Museum Visitors in Conversations*: <https://www.nisenet.org/catalog/nanotechnology-and-society-guide>

⁴⁶ Professional societies focused specifically on the study of science, technology, and society (STS) include:

Society for Social Studies of Science (4S): <https://www.4sonline.org/sts-resources/professional-associations/>

Society for the History of Technology (SHOT): <https://www.historyoftechnology.org>

Academic program lists can be found at: <https://www.historyoftechnology.org/doing-history-of-technology/departments-and-programs-of-study/>

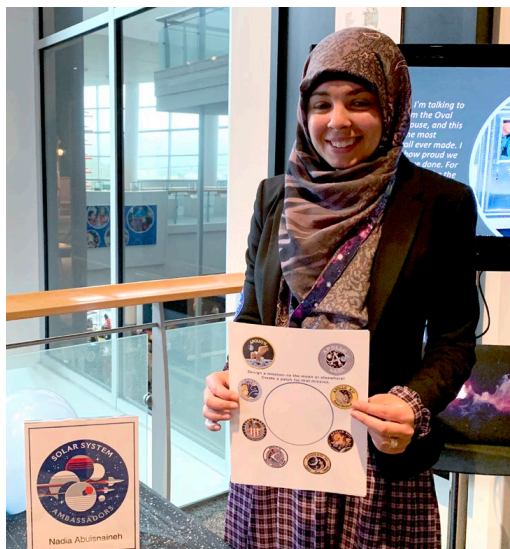
Additional Volunteers for a STEM Event

In addition to finding STEM experts, you may need to recruit other types of volunteers to help with your event. Potential sources of volunteers may include:

- College students, classes, or clubs with community service requirements
- Service-oriented college fraternities and sororities such as:
 - Alpha Phi Omega (APO) co-ed organization on 375 college campuses
<https://apo.org/start-a-chapter/chapter-map/>
 - Professional fraternities and sororities
https://en.wikipedia.org/wiki/Professional_fraternalities_and_sororities
- High school science clubs or students suggested by local high school science teachers
- Drama and theater students from local colleges
- Local industry staff and retirees
- Local service clubs

Contacting Experts

Once you have some idea of the kinds of experts you would like to recruit for a project or event, you will need to begin contacting them and inviting them to participate. Keep in mind that you may need to cast a wide net to find experts who have interest and capacity to work with you.



Steps for Inviting Experts to Participate

Start early!

- Experts are busy people, so give them as much advance notice as possible

Cast a wide net

- Keep in mind that many people you contact may not respond
- Many experts may not be able to participate due to time constraints and prior commitments
- Seek advice and suggestions for additional people from those who respond
- Ask experts you have worked with before about ideas they may have
- Ask people you know (staff, volunteers, board, sponsors) for suggestions

Craft a clear written email message with your request

- Be sure to briefly introduce yourself and your institution
- Describe the commitment request
- Be clear if this is a volunteer request or if you are offering some type of compensation
- Provide key logistical details for events
- Write the message so that it can easily be shared with others (if appropriate)
- Ask about their interest and availability

Create a simple recruiting flyer

- Design a flyer that can be posted and shared physically and virtually
- A flyer is appropriate for situations where you are seeking many volunteers such as a large event or inviting a group to a training orientation

Make personal phone calls

- Phone calls can be more effective in getting a response than emails
- If you call, always follow up with a written email with details

Stay in contact

- Follow up with reminders and confirm logistical details in writing
- Provide information they will need to know about your facility (transportation details, access) and/or project (background, contact information)

Maintaining and Deepening Relationships

When you find a STEM expert that you enjoy working with, the next steps are to slowly nurture and grow your partnership over time. Effective partnerships require nurturing, understanding, and mutual respect.

Nurturing these relationships is a way to build long-lasting ties to individuals and organizations within your community. Not every relationship with your institution will continue, but many are worth building upon. Over time, some of these partnerships may deepen and change in positive ways that you might not have originally anticipated. If a relationship does deepen to the point of joint projects, consider developing a written agreement about goals, plans, timelines, roles, and responsibilities to clarify understandings and future participation.^{47,48}

⁴⁷ To learn more about partnering with a research center please see: *A Guide to Building Partnerships Between Science Museums and University-Based Research Centers*: <https://www.nisenet.org/riseguide>

⁴⁸ For general collaboration advice see: *NISE Network Museum & Community Partnerships: Collaboration Guide* and additional resources: <https://www.nisenet.org/collaboration-guide>

Ways to Maintain Contact and Show Your Appreciation

- Send a follow-up thank-you note to experts who have participated in an event
- Share attendance statistics and photos of events if experts require documentation of their participation. Experts appreciate receiving photos showing their participation in an event (Note: Obtain signed photo releases of all people in shared photos)
- Invite them to events you think they might be interested in
- Get to know them by inviting them to an informal event attended by staff, volunteers, and advisors
- Offer them a free pass to your institution or an event
- Subscribe them to your institution's electronic newsletter
- Periodically reach out and touch base via email or phone
- Keep a list of experts and maintain their contact information
- Recognize their effort and invite them to a volunteer-appreciation event
- Look for ways to publicly thank volunteer experts (social media, newsletter, etc.)

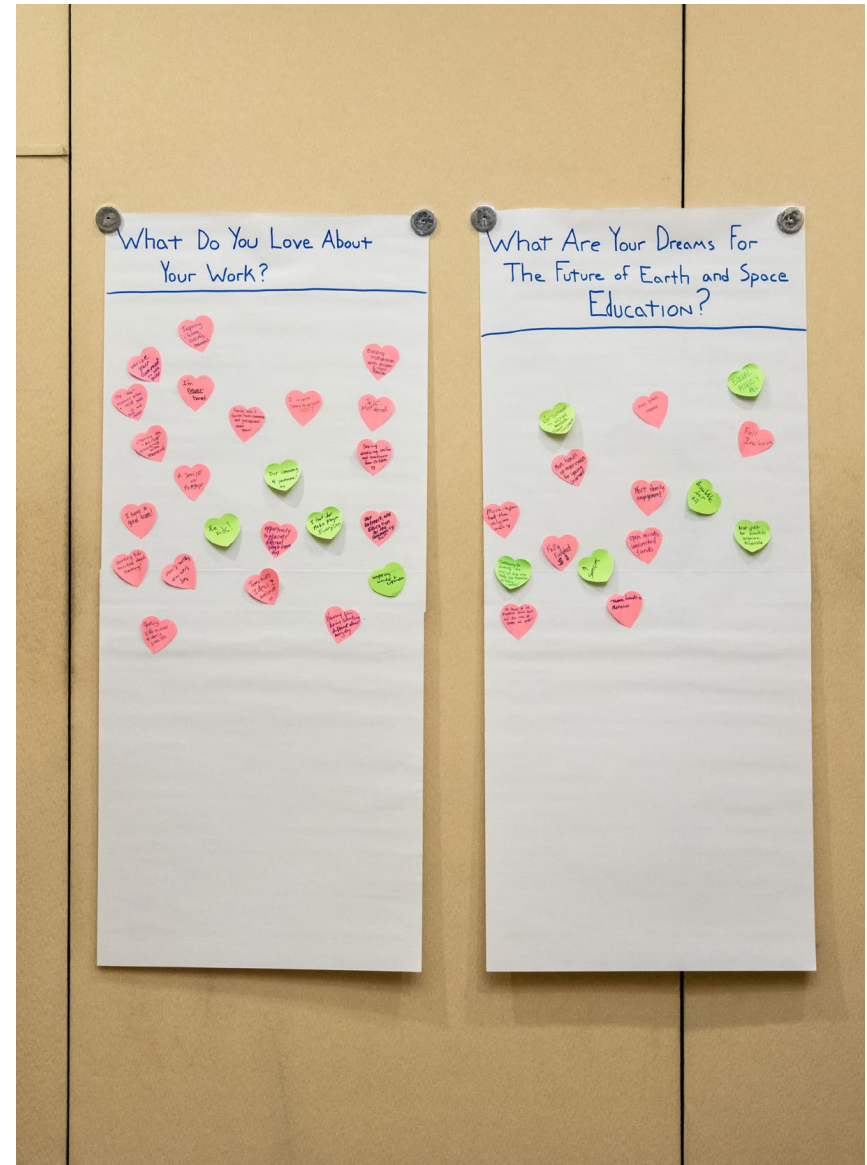


Reflecting on Your Experiences

A useful process is to reflect upon your experience working with experts with a lens toward improving this specific relationship as well as future partnerships. This process can take many forms, including:

- Hold a debriefing conversation following an event with your own staff to reflect upon what went well and what could be improved.
- Send a short written questionnaire to the experts who participated in an event to share their thoughts about their experiences and ask if they would have liked any additional preparation now that they have attended the event. Make time to talk with experts involved in ongoing projects to reflect upon challenges, successes, and what could be improved.
- Conduct an informal focus group with a handful of experts you worked with in the past year to learn about their experiences. Discuss with staff how this feedback might change your institution's partnering process.

These reflection activities do not need to be burdensome. Reflective practice is an established method to deepen your ongoing relationships with local experts.⁴⁹



⁴⁹ For evaluation capacity building resources see: Pattison, S., Cohn, S., & Kollmann, L. (2014). *NISE Network Team-based inquiry: A practical guide for using evaluation to improve informal education experiences*. Second edition. <https://www.nisenet.org/catalog/team-based-inquiry-guide>

SECTION 6

Finding STEM Experts by Subject Area

The following is a list of resources for connecting experts by STEM disciplines. Some of these resources may work for multiple disciplines. A list of relevant annual events is also included with each subject area as a helpful reminder to upcoming partnership opportunities with experts.

Please note that this section is intended to be a starting place for inspiration rather than an exhaustive list of all professional scientific societies. A good resource for many professional societies can be found at the American Association for the Advancement of Science (AAAS) affiliated societies at:

<https://www.aaas.org/group/60/list-aaas-affiliates>





Chemistry and Physics

Colleges and Universities

- You may find experts at a local college in chemistry, chemical engineering, and physics programs. Many chemistry and physics departments have traveling demo shows and public outreach programs. Many chemistry departments are already active in annual events such as National Chemistry Week and Chemists Celebrate Earth Week.

Student Groups

- High school chemistry and physics teachers may be willing to serve as experts; they also may be able to suggest high school students who could volunteer at your event to facilitate hands-on activities.
- **High School ChemClubs**
There are over 600 high school ChemClubs; many of these clubs do outreach with younger students. Find out whether a high school near you has an active ACS ChemClub at:
<https://www.acs.org/content/acs/en/education/students/highschool/chemistryclubs/directory.html>
- **American Chemical Society (ACS) Student Chapters**
ACS has student chapters located on many college campuses around the world. Once you find the name of a student chapter, please contact undergrad@acs.org to reach out to their faculty advisor. To find the closest chapter to you, please visit:
<https://www.acs.org/content/acs/en/education/students/college/studentaffiliates/find-a-chapter.html>

- **Society of Physics Students (SPS)**

The SPS has more than 843 chapters at colleges and universities across the country:

<https://www.spsnational.org/about/governance/chapters>

- **SPIE Student Chapters**

SPIE, the international society for optics and photonics, has student chapters and clubs at universities around the world. SPIE has educational outreach resources on light, lasers, and optics as well as the International Day of Light:

<https://spie.org/membership/student-services/student-chapters>

<https://spie.org/education/education-outreach-resources>

Professional Societies

- **American Chemical Society (ACS)**

- ACS has 185 local sections organized geographically throughout the U.S. To find contact information for your state please visit:
https://lslookup.acs.org/lslookup/local_search
- National Chemistry Week coordinators (annual event mid-October): ACS maintains a list of National Chemistry Week coordinators that is searchable by state and zip code:
<https://www.ncwlookup.acs.org/ncwlookup>
- Chemists Celebrate Earth Week coordinators (annual event mid-April): ACS also maintains a list of Chemists Celebrate Earth Week coordinators that is searchable by state and zip code:
<https://www.ccedlookup.acs.org>
- American Chemical Society (ACS) Experts: The ACS Experts are chemists and chemical engineers who provide reliable, in-depth analysis and respond to inquiries on a wide range of topics in the news and of interest to the public and policymakers:
<https://www.acs.org/content/acs/en/pressroom/experts.html>

- **American Physical Society (APS)**

- APS physicists have sections organized geographically. You can look up each section's executive committee:
<https://www.aps.org/membership/units/sectionmap.cfm>
- APS also has a chapter program affiliated with colleges:
<https://www.aps.org/membership/chapters.cfm>
- APS' Physicists To-Go program is designed to bring physicists to school classrooms in person or virtually; a sign-up request form is available:
<https://www.aps.org/programs/outreach/physiciststogo.cfm>

- **National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE)**

- NOBCChE has both professional and student chapters organized geographically:
<https://www.nobcche.org/chapters>

Local Industry and Professionals

- Many professional chemists can be located through American Chemical Society local sections or employers of chemists, such as pharmaceutical companies, food processing, energy companies, biomedical labs, manufacturing, and water treatment plants.
- **American Chemistry Council** is an industry association of member companies. A map of member companies can be found at:
<https://www.americanchemistry.com/chemistry-in-america/chemistry-in-your-community>
A list of manufacturing members is available at:
<https://www.americanchemistry.com/about-acc/membership/manufacturer-members>

Annual Events

For a full list of events and resources throughout the year see:

<https://www.nisenet.org/seasons>

- National Battery Day (February 18)
- NanoDays (end of March–early April)
- Earth Day (April 22)
- Chemists Celebrate Earth Day (mid-April)
- International Day of Light (May 16)
- National Nano Day (October 9)
- National Chemistry Week (third week in October)
- Mole Day (October 23)
- Halloween (October 31)

NISE Network Resources

- Explore Science: Let's Do Chemistry kit:
<https://www.nisenet.org/chemistry-kit>
- National Chemistry Week resources:
<https://www.nisenet.org/ncw>
- NanoDays kits:
<https://www.nisenet.org/nanodays>
- Light activities:
<https://www.nisenet.org/light>
- Frankenstein200 kit:
<https://www.nisenet.org/frankensteinkit>
- Halloween resources:
<https://www.nisenet.org/halloween>



Space and Earth Science

Please also see the section focused on environmental sciences.

Colleges and Universities

- You may find experts at a local college in astronomy, astrophysics, physics, planetary science, geology, meteorology, aeronautical engineering, mechanical engineering, and other Earth science programs.
- **NASA Space Grant Consortium**
Seek out the NASA Space Grant Consortium program in your state. The Space Grant Consortium is a national network of colleges and universities that has locations in all 50 states, the District of Columbia, and Puerto Rico.
https://www.nasa.gov/stem/spacegrant/home/Space_Grant_Consortium_Websites.html

Student Groups

- Local colleges and high schools may have student clubs or interest groups, especially for astronomy.

Professional Societies

- Your community may have members of professional societies in related topics, for example:
 - **American Astronomical Society (AAS)** maintains a directory of members that can be searched by city and state as well as specialization:
<https://aas.org/directory>

AAS also has an Astronomy Ambassador program for hands-on science:

<https://aas.org/education/roster-aas-astronomy-ambassadors>

- **American Geophysical Union (AGU)** sections are organized by specialization rather than geographically:
<https://www.agu.org>
AGU Thriving Earth Exchange promotes community collaborations to solve local challenges related to natural resources, climate change, and natural hazards:
<https://thrivingearthexchange.org/projects/>

Affinity Groups

- **The Solar System Ambassadors Program (SSA)**
This is a STEM public engagement program designed to work with motivated volunteers across the nation. These volunteers communicate the excitement of NASA's space exploration missions and information about recent discoveries to people in their local communities. As of 2021, there are more than 1,000 ambassadors in all 50 states, Washington DC and U.S. territories, military bases, and consulates overseas. Volunteer ambassadors bring the excitement of space to the public. Ambassadors are space enthusiasts from various walks of life who are interested in providing greater service and inspiration to the community at large.
<https://solarsystem.nasa.gov/ssa/>
- **The Night Sky Network**
This is a nationwide coalition of amateur astronomy clubs bringing the science, technology, and inspiration of NASA's missions to the general public. Night Sky Network members share their time and telescopes to provide unique astronomy experiences at science museums, observatories, classrooms, and outdoors under the night sky.
<https://nightsky.jpl.nasa.gov>

- **AAS Astronomy Ambassadors**

This program was created by the American Astronomical Society (AAS), in partnership with the Astronomical Society of the Pacific (ASP), members of the Center for Astronomy Education (CAE), and other organizations active in science education and public outreach. AAS Astronomy Ambassadors provides mentoring and training experiences for young astronomers, from advanced undergraduates to new faculty. It also provides access to resources and a network of contacts within the astronomy EPO community.
<https://aas.org/education/roster-aas-astronomy-ambassadors>

Local, State, and Federal Agencies

- **NASA's Universe of Learning Subject Matter Experts**

NASA's Universe of Learning works to ensure that astronomy and astrophysics Subject Matter Experts (SMEs) are paired with educators and learners in a way that makes sense. If you are working on a product or an event and have an opportunity that could be enhanced with a scientist SME, you may submit a request here:
<https://www.universe-of-learning.org/subject-matter-experts>

- **NASA Speakers Bureau**

The NASA Speakers Bureau is composed of engineers, scientists, and other professionals who represent the agency as speakers at civic, professional, educational, and other public venues. Please note that Speakers Bureau requests for in-person or virtual speakers must be made in advance via an online form:
<https://www.nasa.gov/about/exhibits/index.html>

- **NASA Astronaut appearance requests**

NASA offers both in-person and virtual options when requesting an astronaut appearance. All astronaut appearance requests must follow specific instructions as well as meet required conditions for

events. Please note that all requests require at least 6–10 weeks to process. Learn more about how to submit a request:

<https://www.nasa.gov/about/speakers/astonautappearances.html>

- **NASA Museum & Informal Education Alliance**

The Museum & Informal Education (MIE) Alliance is a professional development network that brings current NASA science and technology to informal education providers and assists with access to NASA staff and materials. Serving over 1,200 member organizations across the country, the Alliance is the starting point for informal educators seeking free NASA educational resources and services.

- To learn more and apply for free Alliance membership:

<https://informal.jpl.nasa.gov/museum/About>

- To find and connect with your local Alliance member:

<https://informal.jpl.nasa.gov/museum/Connect>

- Tips on getting NASA speakers (free membership login required):

<https://informal.jpl.nasa.gov/museum/content/nasa-speakers>

- Calendar of NASA-related events, anniversaries, and celebrations:

<https://informal.jpl.nasa.gov/museum/calendar>

Cultural Perspectives

- Find Indigenous, Black and African American, Hispanic and Latinx, and Asian and Pacific Islander storytellers, elders, and experts who can share local and historical knowledge as well as their experiences and traditions, particularly as they reflect on the night sky, our Earth, and space exploration.

- Seek out Indigenous community leaders in your area who have local knowledge and perspectives to share. Please see the section of this guide on Indigenous Ways of Knowing.
- For astronomy examples see: Andrew Fraknoi (2020) The Astronomy of Many Cultures: A Resource Guide, Fromm Institute, U. of San Francisco, Version 5.1; July 2020.
https://astrosociety.org/file_download/inline/eb3601be-8e70-4f11-8e12-3c8c5b52e66a

Annual Events

For a full list of events and resources throughout the year see:

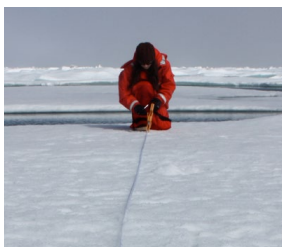
<https://www.nisenet.org/seasons>

- Celestial Events (star parties, meteor showers, full Moon, planetary events, comet viewings, eclipses)
- NASA-related events, mission launches, first images, sample returns, anniversaries, and celebrations:
<https://informal.jpl.nasa.gov/museum/calendar>
- Solar Week (last full week in March)
- Global Astronomy Month (April)
- Citizen Science Month (April)
- Yuri's Night (April 12)
- Black Hole Week (mid-April)
- Astronomy Day/Week (spring, held in April or May)
- International Dark Sky Week (first week in April)
- Earth Day (April 22)
- National Environmental Education Week (week of Earth Day)
- May the Fourth Be With You–Star Wars Day (May 4)

- International Day of Light (May 16)
- National Paper Airplane Day (May 26)
- Asteroid Day (June 30)
- Moon Landing–anniversary of Apollo 11 (July 20)
- International Observe the Moon Night (date selected in September/October)
- Astronomy Day/Week (fall, held in September/October)
- World Space Week (October 4–10)
- Earth Science Week (second full week in October)
- Solar Week (mid-October)
- Black Hole Friday (last Friday in November)

NISE Network Resources

- Explore Science: Earth & Space toolkits:
<https://www.nisenet.org/earthspacekit>
- Earth Day resources:
<https://www.nisenet.org/earthday>
- NISE Network Online Workshop Recording: Finding and Collaborating with Astronomy Experts and Volunteers (recorded 2017):
<https://www.nisenet.org/catalog/online-workshop-finding-and-collaborating-astronomy-experts-and-volunteers-recorded>



Environmental Sciences

Natural Resources, Ecology, Earth Sciences, Geology, Meteorology, Climate, and Sustainability

Please also see the section focused on space and Earth science.

Colleges and Universities

- You may find experts at a local college in environmental science, environmental education, natural resources, environmental engineering, civil engineering, urban planning, biology, ecology, geology, hydrology, atmospheric science, meteorology, geography, oceanography, and sustainability programs.
- **Many land grant colleges and universities** are also home to Cooperative Extension offices with local experts on various topics, including agriculture, natural resources, 4-H youth development, family and consumer science, food, gardening, and many environmental topics.
 - Map and list of land grant colleges:
<https://nifa.usda.gov/land-grant-colleges-and-universities-partner-website-directory>
 - Most counties within the U.S. have a Cooperative Extension office that may include many types of expertise, including agriculture services, gardening advice, and insect identification:
<https://www.gardeningknowhow.com/extension-search>

Student Groups

- Local colleges and high schools may have student clubs or interest groups dedicated to environmental issues and local action.

Professional Societies

- Your community may have members of professional societies that may be able to provide expertise in a variety of related areas.
- **Ecological Society of America** is organized into chapters by geography and sections by topic:
<https://www.esa.org/about/esa-membership-structure/>
- **American Meteorological Society (AMS) chapters:**
 - American Meteorological Society (AMS) chapters are organized geographically, located throughout the U.S. and Puerto Rico, and are a source of local expertise that can help promote science education and speak to groups about weather- and climate-related topics:
<https://www.ametsoc.org/index.cfm/ams/about-ams/ams-local-chapters/chapter-listing/>
 - American Meteorological Society (AMS) offers professional certification programs that identify broadcast and consulting meteorologists who have achieved a high level of competency in communicating complex weather, water, and climate information. Check to see if your local radio and television weather broadcaster is designated as a Certified Broadcast Meteorologist (CBM) or is AMS certified:
<https://www.ametsoc.org/index.cfm/ams/education-careers/careers/ams-professional-certification-programs/directories-of-ams-certified-individuals/>
 - Search the AMS Weather and Climate Service Providers Directory by zip code for local experts:
<https://wcdirectory.ametsoc.org/home>

- **Geological Society of America (GSA)** has a local Campus Rep program with nearly 500 reps at two-year and four-year university campuses:
https://www.geosociety.org/GSA/membership/Campus_Reps/GSA/Membership/Campus_Reps.aspx
- **American Geophysical Union (AGU)** sections are organized by specialization rather than geographically:
<https://www.agu.org>
- **AGU Thriving Earth Exchange** promotes community collaborations to solve local challenges related to natural resources, climate change, and natural hazards:
<https://thrivingearthexchange.org/projects/>
- **American Planning Association (APA)** has local chapters in many states:
<https://www.planning.org/chapters/>
- **North American Association of Environmental Educators (NAEE)** groups are organized by topics:
<https://naaee.org/eepr/groups>

Local, State, and Federal Agencies

- Many local, state, and federal agencies have expertise and public education resources on relevant subjects, including water quality, wastewater, recycling, solid waste, hazardous waste, air quality, conservation, wildlife, forestry, land use, environmental quality, transportation, climate, and sustainability.
- **NOAA National Weather Service meteorologists:**
 - Local National Weather Service offices:
<https://www.weather.gov/contact>
 - Virtual presenters:
<https://www.weather.gov/epz/education>

• NOAA Sea Grant:

- Sea Grant is made up of a network of thousands of professionals working in every coastal and Great Lakes state as well as in Guam and Puerto Rico. Additional projects extend Sea Grant's professional network to the Virgin Islands, Marianas Islands, and other U.S. territories as well as to inland states. Subjects include coastal ecology and biology, fisheries biology, aquaculture technology and business, climate change science, community resilience to natural change, economics, social science, youth and adult education, and more.
- NOAA Sea Grant Address Book by expertise and location:
<https://seagrants.noaa.gov/professionals>

• NOAA Regional Integrated Sciences and Assessments Program (RISA):

- NOAA's RISA teams support research and engagement on climate-related issues in several regions across the U.S.:
<https://cpo.noaa.gov/Meet-the-Divisions/Climate-and-Societal-Interactions/RISA/RISA-Teams>

• State and Regional Climatologists:

- American Association of State Climatologists is a professional scientific organization composed of state climatologists (one per state) and directors of the six Regional Climate Centers:
https://stateclimate.org/state_programs
https://stateclimate.org/regional_programs/

• Federal public lands and resource management agencies:

- **U.S. Fish and Wildlife Service** maintains many wildlife refuges across the country:
<https://www.fws.gov/refuges/profiles/bystate.cfm>

- **The National Park Service** employs many scientists and researchers across their network of parks and monuments:
<https://www.nps.gov/findapark/index.htm>
- **USDA National Forest Service** manages national forests and grasslands across the country:
<https://www.fs.usda.gov/visit/forests-and-grasslands>
Interactive visitor map:
<https://www.fs.fed.us/ivm/>
- **Bureau of Land Management (BLM)**: manages more than 245 million acres of public land across the country:
<https://www.blm.gov/about/what-we-manage>
Interactive map:
<https://www.blm.gov/visit>

Local Industry and Professionals

- **Energy providers:** Local electricity and power utility companies typically have energy conservation and alternative energy education programs, as well as practical information about local opportunities.
- **Building professionals:** Local architects, designers, and builders who specialize in green buildings and energy efficiency can highlight work on projects in your region.
- **Local news media meteorologists** are skilled science communicators and are often very willing to offer their expertise. The American Meteorological Society (AMS) offers a Certified Broadcast Meteorologist (CBM) program (see details above).

Affinity Groups

- Your community may have many naturalists and environmental groups or individuals, including birders, gardeners, and composters.

- A few examples of affinity groups with local chapters are:

- **Native plant societies and clubs:**
<https://ahsgardening.org/gardening-resources/societies-clubs-organizations/native-plant-societies/>
- **National Audubon Society chapters:**
<https://www.audubon.org/about/audubon-near-you>
- **Sierra Club local chapters:**
<https://www.sierraclub.org/chapters>
- **Sunrise Movement climate change youth movement hubs:**
<https://www.sunrisemovement.org/hubs/>

Cultural Perspectives

- Seek out Indigenous community leaders in your area who have local knowledge and perspectives to share. Please see the section of this guide on Indigenous Ways of Knowing.

Annual Events

For a full list of events and resources throughout the year see:

<https://www.nisenet.org/seasons>

- Groundhog Day (February 2)
- National Engineers Week (February)
- Severe Weather Awareness Week (March, month varies by state)
- Groundwater Awareness Week (second full week in March)
- Earth Hour (mid-March)
- World Water Day (mid-March)
- Spring Equinox (March 19 or 20)

- Summer Solstice (June 20 or 21)
- Fall Equinox (September 22 or 23)
- Winter Solstice (December 20 or 21)
- National Learn about Butterflies Day (March 14)
- National Kite Month (April)
- Citizen Science Month (April)
- Earth Day (April 22)
- Arbor Day (last Friday in April)
- Caribbean Mosquito Awareness Week (May)
- National Environmental Education Week (week of Earth Day)
- Lightning Safety Awareness Week (June)
- World Environment Day (June 5)
- World Oceans Day (June 8)
- National Mosquito Control Awareness Week–Fight the Bite (last full week in June)
- Plastic Free July (July)
- National Aviation Day (August 19)
- World Mosquito Day (August 20)
- World Cleanup Day (mid-September)
- International Coastal Cleanup Day (third week in September)
- National Pollution Prevention Week (P2 Week) (third week in September)
- National Bike Month (September)
- Bike to Work Week (third week in September)

- Earth Science Week (second full week in October)
- National Chemistry Week (third full week in October)
- Campus Sustainability Month (October)
- Imagine a Day Without Water (mid-October)
- World Tsunami Awareness Day (November 5)
- America Recycles Day (November 15)

NISE Network Resources

- Sustainability in Science and Technology Museums:
<https://www.nisenet.org/sustainability>
- SustainABLE kit:
<https://www.nisenet.org/sustainable-kit>
- Explore Science: Earth & Space toolkits:
<https://www.nisenet.org/earthspacekit>
- Earth Day resources:
<https://www.nisenet.org/earthday>
- Moon:
<https://www.nisenet.org/moon>
- Lunar Eclipses:
<https://www.nisenet.org/lunareclipse>
- Solar Eclipses:
<https://www.nisenet.org/solareclipse>
- Asteroids, Comets, Meteors, and Meteorites:
<https://www.nisenet.org/asteroids>



Agriculture

Food Science, Animal Science,
and Plant Science

*Please also see the sections on environmental
sciences and Earth sciences.*

Colleges and Universities

- You may find experts at a local college in agricultural, animal, and plant sciences programs; seek out specialized expertise in fields such as zoology, agronomy, soil science, entomology, plant genetics, botany, agricultural and biological engineering, and veterinary programs.
- **Many land grant colleges and universities** are also home to Cooperative Extension offices with local experts on various topics including agriculture, natural resources, 4-H youth development, family and consumer science, food, gardening, and many environmental topics:
 - Map and list of land grant colleges:
<https://nifa.usda.gov/land-grant-colleges-and-universities-partner-website-directory>
 - Most counties within the U.S. have a Cooperative Extension office that may include many types of expertise including agriculture services, gardening advice, and insect identification:
<https://www.gardeningknowhow.com/extension-search>

Student Groups

- Local colleges and high schools may have student clubs or interest groups; examples include:

- **Future Farmers of America (FFA):**
<https://www.ffa.org/chapter-locator/>
- **4-H programs** are located in counties throughout the U.S.:
<https://4-h.org/find/>

Professional Societies

- Your community may have members of professional societies in related topics, for example:
 - **American Society of Plant Biologists (ASPB)** has geographical local sections and you can see a list of section officers:
<https://aspb.org/membership/aspb-sections/>
 - **International Society of Arboriculture (ISA)** has a geographic directory of certified arborists:
<https://www.treesaregood.org/findanarborist/findanarborist>
 - **American Beekeeping Federation (ABF)** has a director of state and local associations and clubs:
<https://www.abfnet.org/page/states>

Local, State, and Federal Agencies

- Many local, state, and federal agencies have expertise and public education resources on relevant subjects, including agriculture, wildlife, fish, game, forestry, and invasive species.
- **USDA Natural Resources Conservation Service (NRCS)** provides farmers and ranchers with technical expertise and are organized geographically by USDA Service Centers located in counties throughout the U.S.:
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/contact/local/>

Local Industry and Professionals

- Examples include experts from farms, orchards, dairies, plant nurseries, animal breeders, fishing, seafood, veterinarians, breweries, etc.
- Farm Bureau state organizations list:
<https://www.fb.org/about/join>

Affinity Groups

- Local expertise can be found in gardening groups, composters, and farmers markets.

Annual Events

For a full list of events and resources throughout the year see:

<https://www.nisenet.org/seasons>

- National Bird Day (January 5)
- National Learn about Butterflies Days (March 14)
- National Dairy Month (June)
- World Oceans Day (June 8)
- National Ag Day (mid-March)
- Food-themed celebrations

NISE Network Resources

- Building with Biology kit:
<https://www.nisenet.org/building-with-biology-kit>
- Food activities:
<https://www.nisenet.org/food>



Biology and Biomedical Sciences

Genetics, Synthetic Biology,
and Public Health

Colleges and Universities

- You may find experts at a local college in biology, genetics, microbiology, molecular biology, biological engineering, health, medicine, nursing, optometry, and dental programs.

Student Groups

- Local colleges and high schools may have student clubs or interest groups; examples include:
 - **iGEM** synthetic biology student teams and alumni:
https://igem.org/Team_List
 - **Society for Biological Engineers** student chapters:
<https://www.aiche.org/sbe/community/students/chapters>

Professional Societies

- Your community may have members of professional societies in related topics, for example:
 - **American Society for Biochemistry and Molecular Biology (ASBMB)** ASBMB has thousands of members in the U.S.; a list of student chapters is available here:
<https://www.asbmb.org/education/student-chapters/find>

- **American Society for Microbiology (ASM)** ASM has Branches, Young Ambassadors, and Student Chapters that can be found with a searchable map:
<https://asm.org/Map/>
- **American Medical Association (AMA)** Search the AMA Federal Directory to find contact information for state, county, and national medical specialty societies; use filters to narrow your search or create custom lists arranged by state, county, or specialty:
<https://federationdirectory.ama-assn.org/federations>
- **American Nurses Association** List of State Nurses Associations:
<https://www.nursingworld.org/membership/find-my-state/>

Local, State, and Federal Agencies

- Local public health departments focus on a variety of health topics, including infectious disease, immunization, food safety, disease prevention, injury prevention, mental health, child health, and emergency preparedness.
- **National Association of County and City Health Officials (NACCHO)** maintains a directory searchable by state and zip code:
<https://www.naccho.org/membership/lhd-directory>
- **National Institutes of Health (NIH) “All of Us”** is a research program that aims to build a diverse database of health information to advance individualized healthcare for everyone; a list of community engagement partners is available here:
<https://allofus.nih.gov/funding-and-program-partners/communications-and-engagement-partners>

Local Industry and Professionals

- Local medical professionals and hospitals are a good place to start to find local experts.
- **Personal Genetics Education Project (pgED)**
Founded in 2006 in the Department of Genetics at Harvard Medical School, pgEd is a team of scientists, social scientists, educators, and community organizers who develop resources and offer expert perspectives for community engagement with issues in genetics:
<https://pged.org/community-connections/>
- For biological engineering and synthetic biologists, explore the **Engineering Biology Research Consortium** members:
<https://ebrc.org/focus-areas/members/>
- For synthetic biologists, search Find an Expert on the **BioPACIFIC NSF Materials Innovation Platform**:
<https://biopacificmip.org/platform/expertise>

Affinity Groups

- **American Red Cross** offers outreach programs on many topics, including emergency medical care, training, and disaster preparedness. Find your local Red Cross by zip code:
<https://www.redcross.org/find-your-local-chapter.html>
- **DIYBio spaces** are a network of local community labs that provide opportunities and training for citizen scientists, do-it-yourself biologists and engineers, makers, and biohackers:
<https://diybio.org/local/>
<https://sphere.diybio.org/browse/>

Annual Events

For a full list of events and resources throughout the year see:

<https://www.nisenet.org/seasons>

- World Health Day (April 7)
- DNA Day (April 25)
- National Physical Fitness and Sports Month (May)
- Caribbean Mosquito Awareness Week (May)
- National Mosquito Control Awareness Week–Fight the Bite (last full week in June)
- World Mosquito Day (August 20)
- International Day of Radiology & World Radiography Day (November 8)

NISE Network Resources

- Building with Biology kit:
<https://www.nisenet.org/building-with-biology-kit>
- Frankenstein200 kit:
<https://www.nisenet.org/frankensteinkit>



Neuroscience

Colleges and Universities

- You may find experts at a local college in psychology, biology, neuroscience, neurology, and medical programs.

Student Groups

- Local colleges may have student clubs or interest groups attached to biology or psychology departments, for example:
 - **International Youth Neuroscience Association (IYNA)** high school chapters:
<https://youthneuro.org/chapters/>
 - **Society for Neuroscience** chapters are often located at colleges and universities:
<https://my.sfn.org/Directories/SfN-Chapters>

Professional Societies

- Your community may have members of professional societies in related topics, for example:
 - **Society for Neuroscience** describes examples of public programs here:
<https://www.sfn.org/outreach/find-a-neuroscientist>
 - Society for Neuroscience maintains a database to help you connect with neuroscientists in your community who are ready to help you learn and teach about the brain:
<https://www.brainfacts.org/for-educators/find-a-neuroscientist>

- Society for Neuroscience chapters:
<https://my.sfn.org/Directories/SfN-Chapters>
- **International Neuroethics Society** maintains a list of experts willing to receive queries:
<https://www.neuroethicssociety.org/experts>

Local, State, and Federal Agencies

- **National Institute on Neurological Disorders and Stroke (NINDS)**, part of the National Institutes of Health, strives to seek fundamental knowledge about the brain and nervous system and to use that knowledge to reduce the burden of neurological disease for all people. NINDS maintains a list of support resources on their website:
<https://www.ninds.nih.gov/Disorders/Support-Resources>

Local Industry and Professionals

- Medical professionals and hospitals.
- Mental health professionals.

Affinity Groups

- **National Alliance on Mental Illness (NAMI)** has more than 600 NAMI State Organizations and Affiliates across the country, which can be located by zip code:
<https://nami.org/findsupport>
- **American Brain Coalition** is a nonprofit organization comprising leading professional neurological, psychological, and psychiatric associations and patient organizations in the U.S.:
<https://www.americanbraincoalition.org>

- **Alzheimer's Association** leads the way in the fight to end Alzheimer's and all other dementia by accelerating global research, driving risk reduction and early detection, and maximizing quality care and support. Find local chapters through their website: https://www.alz.org/local_resources/find_your_local_chapter
- **Parkinson's Foundation** makes life better for people with Parkinson's disease by improving care and advancing research toward a cure. Find local chapters through their website: <https://www.parkinson.org/get-involved/local-resources>
- **Black in Neuro** is dedicated to celebrating Black excellence in neuroscience-related fields. The group keeps a member directory of those willing to be contacted for speaker engagements: <https://www.blackinneuro.com/member-directory>
- **Dana Foundation** is a private philanthropic organization dedicated to advancing understanding about the brain. The foundation maintains a list of resources to support successful outreach efforts: <https://dana.org/share-science/>

Annual Events

For a full list of events and resources throughout the year see:

<https://www.nisenet.org/seasons>

- Full calendar of brain-related awareness events from the American Brain Coalition: <https://www.americanbraincoalition.org/page/AwarenessCalendar>
- Mental Wellness Month (January)
- Brain Awareness Week (mid-March)
- MS Awareness Week (mid-March)
- Autism Awareness Month (April)

- Parkinson's Awareness Month (April)
- Mental Health Awareness Month (May)
- ALS Awareness Month (May)
- World Brain Day (July 22)
- National Alzheimer's Awareness Month (November)
- National Epilepsy Awareness Month (November)

NISE Network Resources

- Changing Brains resources: <https://www.nisenet.org/brain>



Engineering, Technology, Material Science, and Nanoscale Science

Please also see the sections focused on chemistry, physics, math, and computer sciences.

Colleges and Universities

- You may find experts at a local college in engineering departments, material science, and other applied science departments.

Student Groups

- Many colleges and universities have student groups affiliated with a national professional society, for example:
 - **Society of Women Engineers (SWE)** has over 400 sections at colleges and universities in the U.S.:
<https://swe.org/membership/sections/>
 - **Society for Biological Engineers** student chapters:
<https://www.aiche.org/sbe/community/students/chapters>
 - **Materials Research Society (MRS)** student chapters:
<https://www.mrs.org/university-chapters/list-of-chapters>
 - **FIRST Robotics Teams** are elementary, middle, and high school robotics teams that do a lot of public outreach:
<https://www.firstinspires.org>

Professional Societies

- Your community may have members of professional societies in related topics, for example:
 - **American Society of Civil Engineers (ASCE)** allows you to search geographically by zip code; in North America, ASCE has 76 sections, 160 branches, and 302 student chapters:
https://www.asce.org/Regions_Sections_Branches/
 - **IEEE (Institute of Electrical and Electronics Engineers)** allows you to search geographically for sections, chapters, and affinity groups:
<https://www.ieee.org/communities/regional-world-map.html>
 - **American Indian Science and Engineering Society:**
<https://www.aises.org>
 - **Materials Research Society (MRS):**
<https://www.mrs.org/university-chapters>
 - **National Action Council for Minorities in Engineering:**
<https://www.nacme.org>
 - **MAES–Latinos in Science and Engineering:**
<http://mymaes.org>
 - **National Society of Black Engineers (NSBE):**
<https://www.nsbe.org>
 - **National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE):**
<https://www.nobcche.org/chapters>
 - **Society of Asian Scientists and Engineers:**
<https://saseconnect.org>

- **Society of Hispanic Professional Engineers:**
<https://www.shpe.org>
- **Society of Women Engineers (SWE):**
<https://swe.org/membership/sections/>
- **Society for Advancement of Chicanos and Native Americans in Science (SACNAS):**
<https://www.sacnas.org>

Local, State, and Federal Agencies

- Local public works departments are a good place to seek out transportation, civil, and environmental engineers.

Local Industry and Professionals

- Local engineering and technology businesses including construction companies and engineering firms.

Affinity Groups

- Examples of groups you may seek are local makerspace enthusiasts, software developers, computer coding groups, and amateur radio clubs.
 - **National Association for Amateur Radio (ARRL)** maintains a directory of affiliated radio clubs:
<http://www.arrl.org/find-a-club>
 - **MakerSpaces directory** from Make magazine:
<https://makerspaces.make.co>
 - **Maker Faire directory** from Make magazine:
<https://makerfaire.com/map/>

Annual Events

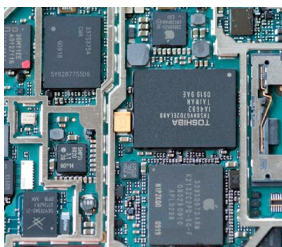
For a full list of events and resources throughout the year see:
<https://www.nisenet.org/seasons>

- National Static Electricity Day (January 9)
- World Radio Day (February 13)
- National Engineers Week (February)
- Introduce a Girl to Engineering Day (February)
- National Battery Day (February 18)
- World Engineering Day for Sustainable Development (March 4)
- Groundwater Awareness Week (second full week in March)
- World Water Day (mid-March)
- NanoDays (end of March–early April)
- National Robotics Week/RoboWeek (second week in April)
- World Quantum Day (April 14)
- International Day of Light (May 16)
- National Week of Making (May 11–17)
- Public Works Week (mid-May)
- International Day of Light (May 16)
- National Paper Airplane Day (May 26)
- International Women in Engineering Day (June 23)
- Manufacturing Day (MFG Day) (first Friday in October)
- National Nano Day (October 9)
- Metric Day (October 10)
- Nuclear Science Week (NSW) (third week in October)

- Artificial Intelligence (AI) – World AI Week (2nd week in October)
- Dark Matter Day (on or around October 31)
- International Day of Radiology & World Radiography Day (November 8)

NISE Network Resources

- NanoDays kits:
<https://www.nisenet.org/nanodays>
- Frankenstein200 kit:
<https://www.nisenet.org/frankensteinkit>



Computer Science, Math, Statistics

Please also see the section on engineering.

Colleges and Universities

- You may find experts at a local college in math, statistics, computer science, information science, electrical engineering, and computer software engineering departments.

Student Groups

- Local colleges and high schools may have student clubs or interest groups; examples include computer coding groups.

Professional Societies

- Your community may have members of professional societies in related topics, for example:
 - **IEEE (Institute of Electrical and Electronics Engineers)** allows you to search geographically for sections, chapters, and affinity groups:
<https://www.ieee.org/communities/regional-world-map.html>
 - **American Indian Science and Engineering Society:**
<https://www.aises.org>
 - **Materials Research Society (MRS):**
<https://www.mrs.org/university-chapters>

- **National Action Council for Minorities in Engineering:**
<https://www.nacme.org>
- **MAES–Latinos in Science and Engineering:**
<http://mymaes.org>
- **National Society of Black Engineers (NSBE):**
<https://www.nsbe.org>
- **National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE):**
<https://www.nobcche.org/chapters>
- **Society of Asian Scientists and Engineers:**
<https://saseconnect.org>
- **Society of Hispanic Professional Engineers:**
<https://www.shpe.org>
- **Society of Women Engineers (SWE):**
<https://swe.org/membership/sections/>

Local, State, and Federal Agencies

- Local information technology and data science specialists.

Local Industry and Professionals

- Examples of local industry include software developers and website professionals.

Affinity Groups

- Examples of groups you may seek are local makerspace enthusiasts, software developers, and computer coding groups.

- **Meetup** can be a starting place to find organizers of Meetup groups near you on a variety of topics:

<https://www.meetup.com/topics/>

Web technology:

<https://www.meetup.com/topics/web/>

Computer science:

<https://www.meetup.com/topics/computer-science/>

- **MakerSpaces directory** from Make magazine:

<https://makerspaces.make.co>

- **Maker Faire directory** from Make magazine:

<https://makerfaire.com/map/>

Annual Events

For a full list of events and resources throughout the year see:

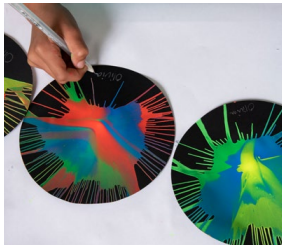
<https://www.nisenet.org/seasons>

- Leap Day (February 29, every four years)
- Pi Day/International Day of Mathematics (March 14)
- Mathematics and Statistics Awareness Month (April)
- National Math Festival (mid-April)
- Metric Day (October 10)
- Computer Science Education Week (CSEdWeek) and Hour of Code (second week in December)

NISE Network Resources

- NanoDays kits:

<https://www.nisenet.org/nanodays>



Incorporating STEM into Arts and Cultural Celebrations

Arts and Cultural Annual Events

Arts and cultural connections are a great way to make STEM content more relevant to your public audiences.

For activity suggestions and resources see:

<https://www.nisenet.org/seasons>

- World Art Day (April 15)
- National Poetry Month (April)
- National Children's Book Week (early May)
- Summer Reading (June–August)
- National STEM/STEAM Day (November 8)

Ways to Celebrate and Highlight People in STEM

Celebrating cultural events is a great way to involve experts, celebrate accomplishments, share stories of historical and living people, and make STEM content more relevant.

For a full list of events and resources throughout the year see:

<https://www.nisenet.org/seasons>

- Science Festivals
- Black History Month/African American History Month (February)

- Women's History Month (March)
- International Women's Day (March 8)
- Asian American and Pacific Islander Month (May)
- Global Accessibility Awareness Day (GAAD) (mid-May)
- Pride Month (June)
- Juneteenth (June 19)
- International Women in Engineering Day (June 23)
- Indigenous Peoples' Day (second Monday in October)
- National Hispanic Heritage Month (September 15–October 15)
- Native American Heritage Month/American Indian and Alaska Native Heritage Month (November)
- Pride in STEM Day (November 18)

Image Credits:

Cover: Marbles Kids Museum / Tierney Farrell
Page 6: Science Museum of Minnesota for NISE Network
Page 7: Dave Burbank for NISE Network
Page 9: Ken Stanek for NISE Network
Page 10: Emily Maletz for NISE Network
Page 11: Children's Creativity Museum for NISE Network
Page 13 left: Museum of Science
Page 13 right: Arizona State University
Page 14: Museum of Science
Page 15: Museum of Science
Page 16 left: Science Museum of Minnesota for NISE Network
Page 16 right: Emily Maletz for NISE Network
Page 17 upper left: Museum of Science
Page 17 lower left: Museum of Science
Page 17 upper right: Museum of Science
Page 17 lower right: The Franklin Institute / Kyle Gronostajski
Page 18: Nic Beery for NISE Network
Page 19: Marbles Kids Museum / Tierney Farrell
Page 20 upper left: Science Museum of Minnesota for NISE Network
Page 20 lower left: Catherine McCarthy for NISE Network
Page 21: Dave Burbank for NISE Network
Page 22: Kayla Berry for NISE Network
Page 23: Emily Maletz for NISE Network
Page 24 upper right: Science Museum of Minnesota for NISE Network
Page 24 lower right: Science Museum of Minnesota for NISE Network
Page 25 upper right: Brad Herring for NISE Network
Page 25 lower right: Science Museum of Minnesota for NISE Network

Page 26 upper right: Science Museum of Minnesota for NISE Network
Page 26 lower right: Science Museum of Minnesota for NISE Network
Page 30: Catherine McCarthy for NISE Network
Page 33: Sciencenter / Gary Hodges for NISE Network
Page 35: Emily Maletz for NISE Network
Page 36: Museum of Science
Page 38 upper left: Museum of Science
Page 38 lower left: Science Museum of Minnesota for NISE Network
Page 39 lower left: Science Museum of Minnesota for NISE Network
Page 39 upper right: Oklahoma WONDERTorium
Page 39 lower right: Science Museum of Minnesota
Page 40: Science Museum of Minnesota
Page 41: Science Museum of Minnesota for NISE Network
Page 42: Science Museum of Minnesota for NISE Network
Page 43: Science Museum of Minnesota for NISE Network
Page 44: Gary Hodges for NISE Network
Page 45: NISE Network
Page 46: Ken Stanek for NISE Network
Page 47: Emily Maletz for NISE Network
Page 49: Emily Maletz for NISE Network
Page 52: NASA / Kathryn Hansen
Page 55: NASA / Cory Huston
Page 58: Science Museum of Minnesota for NISE Network
Page 60: The Franklin Institute / Darryl Moran
Page 62: Sciencenter / Gary Hodges for NISE Network
Page 65: Emily Maletz for NISE Network
Page 67: Emily Maletz for NISE Network