AMERICAN ACADEMY
OF ARTS & SCIENCES

ENCOUNTERING
SCIENCE IN AMERICA

A REPORT FROM
THE PUBLIC FACE OF SCIENCE INITIATIVE

THE PUBLIC FACE OF SCIENCE

ENCOUNTERING SCIENCE IN AMERICA

AMERICAN ACADEMY OF ARTS & SCIENCES
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Please direct inquiries to:
American Academy of Arts and Sciences
136 Irving Street
Cambridge MA 02138-1996
Telephone: 617-576-5000
Email: aaas@amacad.org
Web: www.amacad.org
Twitter: @americanacad

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Preface

Science shapes American society in many ways, from the scientific information that guides fundamental personal choices—like which foods we eat and what products we buy—to the technologies that lead to entirely new industries. Every day, Americans enjoy the benefits of science, including job growth, economic prosperity, cutting-edge disease treatments, and faster communication than ever before. Scientific information also bears on important societal decisions, such as responses to climate change, the opioid epidemic, and environmental contamination.

The essential role of the natural and social sciences in everyday life raises questions about where and how Americans encounter scientific content outside of classroom settings. The improved access to content enabled by new technologies and interactive platforms has changed how Americans consume information and seek entertainment. Social media and podcasting platforms now allow scientists to contribute directly to the public dialogue to an unprecedented extent. At the same time, stories of innovation and investigation that historically have been presented on stage or in movies are now featured on YouTube, Instagram, and Snapchat. Moreover, established science venues such as museums and state/national parks continue to refine pedagogy and experiment with the latest virtual reality and gaming technologies. Despite their ubiquity, little is known about the cumulative impacts of these new experiences on individuals' curiosity about science, trust in scientists, support for scientific research, and understanding of the scientific process.

The goal of this American Academy report is to improve understanding and awareness of this complex landscape of encounters with science among communities interested in participating in or supporting the practices of science communication and engagement. By highlighting several key considerations, such as audience interest, practitioner motivations, and the interconnectivity of science experiences, this report seeks to encourage informed engagement and new scholarship.

This is the second in a series of publications from the Academy's Public Face of Science Initiative, a three-year endeavor to learn more about the complex and evolving relationship between scientists and the public. The first report, *Perceptions of Science in America*, was released in February 2018 and examined the current state of trust in science and scientists. The forthcoming final report will present recommendations for building the capacity for effective science communication and engagement.

The Academy is grateful to the Gordon and Betty Moore Foundation, the Rita Allen Foundation, the Alfred P. Sloan Foundation, and the Hellman Fellows Fund for their generous support of the Public Face of Science Initiative. The Academy also thanks the participants at workshops held in June 2016 and June 2017, as well as the many project advisors whose thoughtfulness and insights contributed to the development of this report.

TOP THREE TAKEAWAYS

from *Encountering Science in America*

1

There is a diverse and expanding range of opportunities for people to encounter science, from visiting science centers and attending science events to participating in scientific research or engaging online.

- Most Americans regularly encounter science content through general news sources, social media, and entertainment.
- The rapid evolution of online platforms is providing new opportunities for science storytelling and extended dialogue. More research is needed to understand fully how online engagement can be effectively used to build a sense of shared understanding and trust.
- Despite the growth of online platforms, attendance at science museums, zoos, aquariums, and other venues and institutions remains strong and these institutions are among the most trusted sources of scientific information.

2

More social science research is needed to understand the impacts of science communication and engagement, including on public interest in, understanding of, and support for science.

- The diverse backgrounds, expertise, and attitudes of individual participants affect short-term outcomes in measurable ways.
- The long-term, cumulative impacts are challenging to assess because of the complex landscape of experiences and a limited understanding of how people move among activities.
- A common language among scholars and practitioners, along with shared metrics and methodologies, is needed to address this knowledge gap and allow for comparative evaluations.

3

Understanding participant motivations is a critical component of effective science communication and engagement.

- Individuals do not necessarily engage in science-centered activities with the sole intention of learning about science. For many people, the desire for social experiences and entertainment may be the primary reason for participating.
- Despite the broad range of individual motivations and outcomes, activities can be designed for specific societal benefits, such as increasing community engagement, providing trusted information on controversial topics, or broadening participation in STEM.

Introduction

In February 2018, the American Academy of Arts and Sciences released the first report from its Public Face of Science Initiative. Titled *Perceptions of Science in America* (see page 35 for its primary conclusions), the report presents data showing that confidence in scientific leaders has remained generally stable over the last thirty years, but that attitudes toward science vary based on age, race, educational attainment, region, political ideology, and other factors. Taken together, these data support the notion of a heterogeneous public whose perceptions depend on context and values.

In addition to the inherent socioeconomic, racial, and cultural diversity of the public, attitudes toward science are also influenced by an individual's experiences with science and exposure to scientific information throughout his or her lifetime. One objective of this report is to **improve understanding and awareness of the range of participants, approaches, and outcomes that form this complex landscape of science communication and engagement among communities interested in participating in or supporting the practice**. The report highlights key contexts for engagement with science and provides an overview of approaches to science communication and engagement. These considerations are particularly important because the design and execution of these activities directly affect their outcomes and impact. A second objective of this report is to **illustrate how science communication and engagement can be designed to achieve specific societal impacts**.

A Heterogenous Public

Percentage of U.S. Adults with a "Great Deal" of Confidence in the Leaders of the Scientific Community:

By Age

48 percent of eighteen-to-thirty-four-year-olds versus **35 percent** of adults sixty-five and older.

By Race

28 percent of black versus **43 percent** of white Americans.

By Education

29 percent of adults who did not graduate from high school versus **50 percent** of adults with a bachelor's degree or higher.

By Region

35 percent of Americans residing in the South versus **47 percent** in the Northeast.

SOURCE: NORC at the University of Chicago, *General Social Survey* (2016). Race was self-identified through the question, "What race do you consider yourself?" Race categories are as reported by NORC. For full demographic data, see American Academy of Arts and Sciences, *Perceptions of Science in America* (Cambridge, Mass.: American Academy of Arts and Sciences, 2018).

The Link between Scientific Research and Public Engagement

Research agencies in the United States have recognized the importance of communication and engagement in the context of federally funded scientific research. The National Science Foundation (NSF) grant merit review requirements codify this relationship through a "broader impacts" (BI) criterion that "encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes."[1] BI goals may include "increased public scientific literacy and public engagement with science and technology."[2] Despite the inclusion of these requirements since 1997, a recent report from the National Alliance of Broader Impacts (NABI) found that "much work remains to clarify BI criterion and how to effectively address it."[3] Several of the recommendations from this NABI report are applicable to the fields of science communication and engagement, such as increasing the capacity of scientists to fulfill BI requirements and providing greater institutional and professional support to expert practitioners. To this end, *Encountering Science in America* conveys the fundamental concepts that scientists and institutions should consider when developing and conducting BI activities.

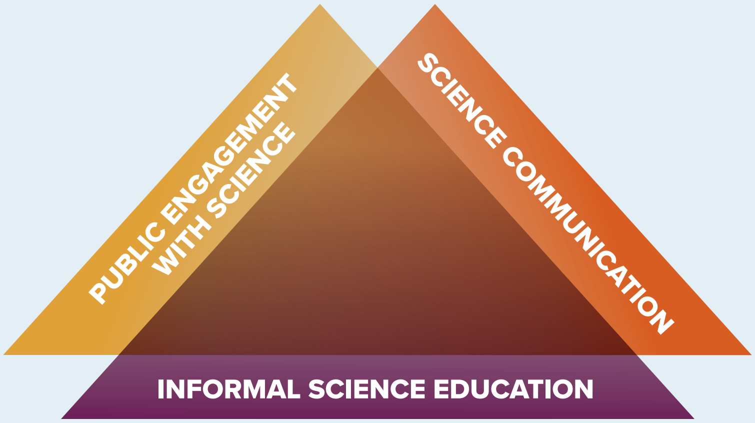
This report is primarily concerned with deliberate efforts to reach general audiences, rather than targeted groups such as policy-makers or K–12 students and educators. **Section 1** of this report presents an overview of a broad conceptual framework for approaching science communication and engagement, with an emphasis on the participants, their motivations, and potential outcomes. It also describes additional resources for science engagement. **Section 2** provides an overview of common ways people engage with and communicate science, including the types of venues and activities, who participates in them, and their motivations for participating. **Section 3** discusses designing science communication and engagement activities for specific impacts, such as broadening participation in science, technology, engineering, and mathematics (STEM).

Individual conversations, news reports, and entertainment also present important opportunities to learn about and interact with scientific content. The special section on **Science in Everyday Life** highlights data from a recent Pew Research Center report that provide insight into trust in science news and experiences with other information sources.

There are diverse and expanding ways for people to encounter science and an increasing effort to evaluate the outcomes of these encounters. However, the cumulative impacts of these experiences on a person's attitudes toward science are not well understood. Continued and expanded support for interdisciplinary collaborations among scholars, professional practitioners, scientists, and communicators will be necessary to achieve a greater understanding of how these experiences contribute to long-term changes in attitudes and behaviors toward science. An improved awareness of the heterogeneous ways people experience science, and the potential outcomes of these experiences, will ultimately enhance efforts that seek to shape the public face of science.

Defining the Practice

While science communication, public engagement, and informal science education have much in common, they can be viewed as distinct fields that share similar goals and practices.[4] Each of these fields may seek to influence the accuracy and accessibility of scientific information, the quality of science-based experiences, and opportunities for direct engagement with content experts. However, informal science education focuses on outcomes associated with learning and public engagement activities whose designs and settings take audiences' interests, prior learning, and culture (or identity) into account. The distinction between science communication, engagement, and education is particularly evident among the practitioners and those who study the practices. The science of science communication—a specialized subfield that studies "how science can best be communicated in different social settings" and the effectiveness of these methods—is one specific example.[5] The rise of this interdisciplinary research has helped advance the practice of science communication and engagement.



PUBLIC ENGAGEMENT WITH SCIENCE The American Association for the Advancement of Science (AAAS) defines "public engagement with science" as "intentional, meaningful interactions that provide opportunities for mutual learning between scientists and members of the public."[6]

SCIENCE COMMUNICATION A National Academies of Sciences, Engineering, and Medicine (NASEM) report on communicating science effectively defines science communication as "the exchange of information and viewpoints about science to achieve a goal or objective such as fostering greater understanding of science and scientific methods or gaining greater insight into diverse public views and concerns about the science related to a contentious issue."[7]

INFORMAL SCIENCE EDUCATION The Center for Advancement of Informal Science Education (CAISE) describes the field of informal science education as pursuing opportunities for "lifelong learning in science, technology, engineering, and math (STEM) that takes place across a multitude of designed settings and experiences outside of the formal classroom."[8]

Science Communication and Engagement: To What End?

This section examines three core elements of science communication and engagement: 1) the diverse categories of participants; 2) the range of motivations that lead each of these groups to participate; and 3) the resulting outcomes, including but not limited to the acquisition of new skills, knowledge, attitudes, or behaviors. The following pages focus on the motivations of, and outcomes for, participants from the public and scientific communities. Despite the heterogeneity within these groups (particularly the public; see next page), there are nevertheless common themes regarding the nuances of their motivations and outcomes. It is necessary to understand these considerations in order to develop effective approaches to science communication and engagement and to evaluate their outcomes.

PARTICIPANTS

MOTIVATIONS

OUTCOMES

Overview of the Participants

The participants in science communication and engagement encompass several major categories, such as supporting institutions, professional practitioners (including scientific experts), and the public. The motivations of these communities influence their approach to science communication and engagement as well as their goals and outcomes. The categorization given below is not an exhaustive list, and not all of these participant groups are involved in every type of activity. For example, translating science into evidence-based policy may involve additional groups, such as policy-makers and/or advocacy organizations, and engagement on social media does not necessarily require institutional support mechanisms.

Supporting Institutions

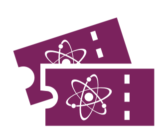
Institutions can provide access to critical resources, from financial and logistical support to the personnel or infrastructure that make science communication and engagement possible. These participants have a significant role in **DEFINING THE OUTCOMES AND POTENTIAL IMPACT**. Supporting institutions include but are not limited to:

NONPROFITS

GOVERNMENTS

PRIVATE SECTOR

UNIVERSITIES



INFORMAL SCIENCE ORGANIZATIONS

Professional Practitioners

Each of the following categories of professionals may possess **EXPERTISE** in science communication, engagement, pedagogy, or, in the case of scientists, a specific subject matter. Moreover, scientists who gain experience and training in science communication and engagement techniques may assume dual roles, becoming facilitators, writers, or producers in addition to content experts. Professional practitioners can include:

"The Public"

There is no singular "public," but rather many publics whose diverse backgrounds, expertise, and experiences can influence the efficacy of science communication and engagement (see Takeaways about the "Public" below).* The term *public* is used here to differentiate general science communication and engagement from more-specialized activities such as communicating about science-based policy, or the day-to-day teaching of science in classrooms. Insights into which members of the public are likely to participate in a given activity can be gained through published research and surveys on participation in similar activities. In addition, science communication and engagement efforts may be designed to reach particular categories of the public, for example:

* Note that the "public" can include scientists, who are members of the general public when participating in activities outside of their field of expertise but generally have more knowledge of the scientific process than the average participant.

Takeaways about the "Public" from *Perceptions of Science in America*:[9]

- Confidence in science varies based on age, race, educational attainment, region, political ideology, and other factors.
- Attitudes toward science are not uniformly associated with one particular demographic group but instead vary based on the specific science issue.
- Recent research suggests that underlying factors such as group identity can strongly influence perceptions about science.

Motivations for Communicating and Engaging

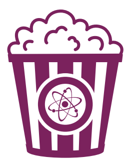
Effective science communication and engagement requires an understanding of what motivates each group of participants to become involved. In many cases, it is not necessary for participants to be motivated by the same objectives, as long as the objectives are compatible. Consider, for example, a citizen science project in which amateur astronomers are trained by scientific experts to submit star observations. The project supports the hobby of amateur astronomers while establishing a new database for scientists interested in furthering their scientific research. Without additional engagement, however, the project might be less effective in stimulating broad public support for government funding for astronomical research.

For Public Participants, Motivations for Engaging with Science Might Include:[10]

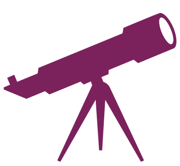
Personal

Self-motivations can include anything from a person's concern about rising sea levels, to curiosity about local wildlife, to desire to have an enjoyable experience. Examples of personal concerns and motivations include:

CURIOSITY



FUN



HOBBYISM

INFORMATION-SEEKING*

* Such as about medical issues or climate change impacts.

Social

Social motivations are based on concern for others or an interest in shared experiences, such as participating in a community event, sharing an experience with a friend, or providing scientific opportunities to children. These could involve:

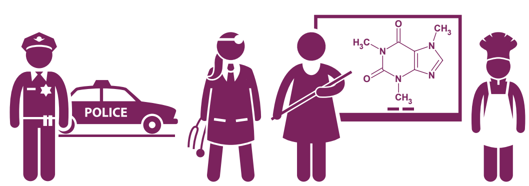
FRIENDS

FAMILY

COMMUNITY

Professional

Professional motivations include seeking out scientific content that is directly or indirectly related to one's career.

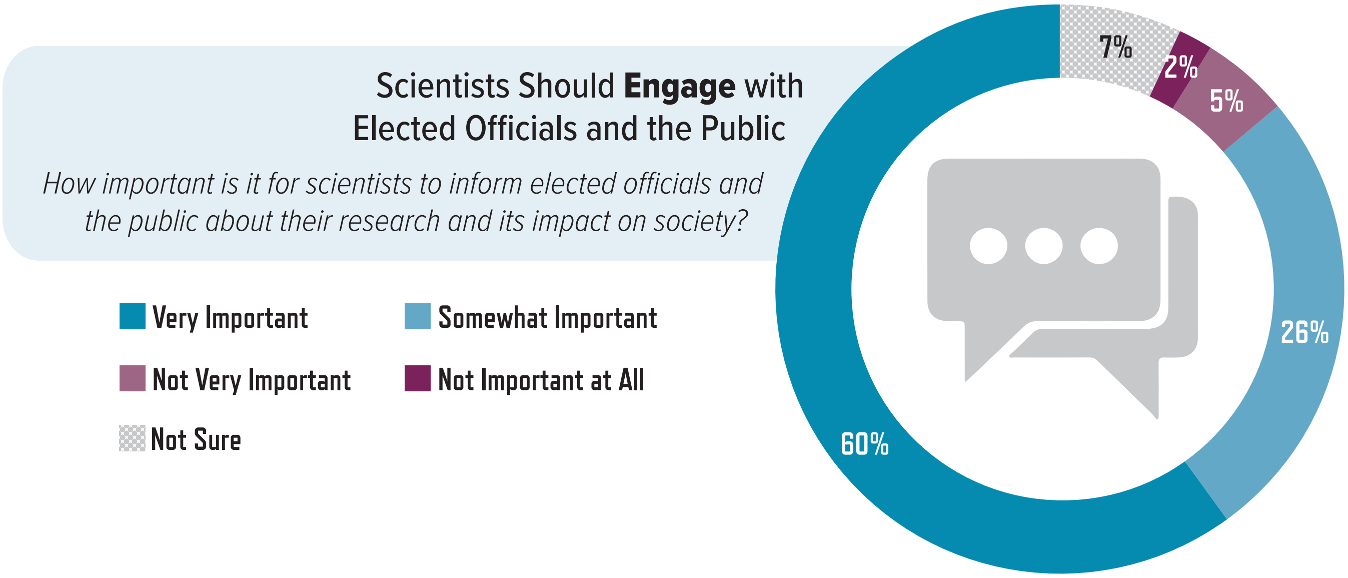


Translating Concept into Practice

Studies show that visitors to zoos and aquariums are particularly diverse in age, prior knowledge, and interests.[11] Heterogeneous groups of visitors can, however, share common motivations, such as information-seeking or an interest in the social experience of their co-attendees.[12] As a result, exhibitions at these institutions are generally designed to appeal to a broad cross section of the public.

Scientists Have a Variety of Personal and Professional Motivations

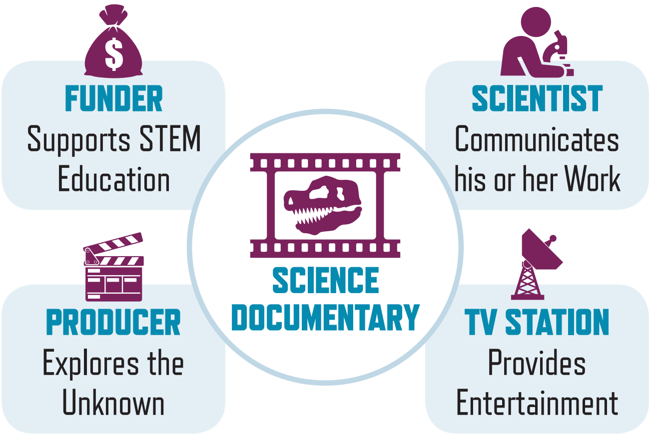
A 2013 survey of Ph.D.-level university scientists in the United States found that "defending science" and "informing the public about science" were high priorities for online public engagement.[13] Other personal motivations included the desire to improve science literacy, the desire to strengthen the perception of science, and personal enjoyment.[14] Participation in communication and engagement activities may also be motivated by funding or job requirements or the desire to increase the visibility of one's personal research. Public demand supports these motivations: a 2017 Research!America survey found that 86 percent of people agreed it was "very" or "somewhat" important for scientists to inform elected officials and the public about their research and its impact.



SOURCE: Research!America, *America Speaks: Poll Data Summary*, Vol. 17 (Arlington, Va.: Research!America, 2017); and Research!America, *Public Perception of Clinical Trials* (Arlington, Va.: Research!America, 2017).

One Activity, Many Motivations

The experts and institutions who organize, facilitate, host, fund, and/or contribute to science communication and engagement activities have diverse and sometimes conflicting motivations. The following example demonstrates how the motivations of funders, producers, scientists, and disseminators can converge as part of a shared activity. In this example, all the participants share the goal of developing a science documentary series, but have distinct motivations for their involvement and seek different outcomes.

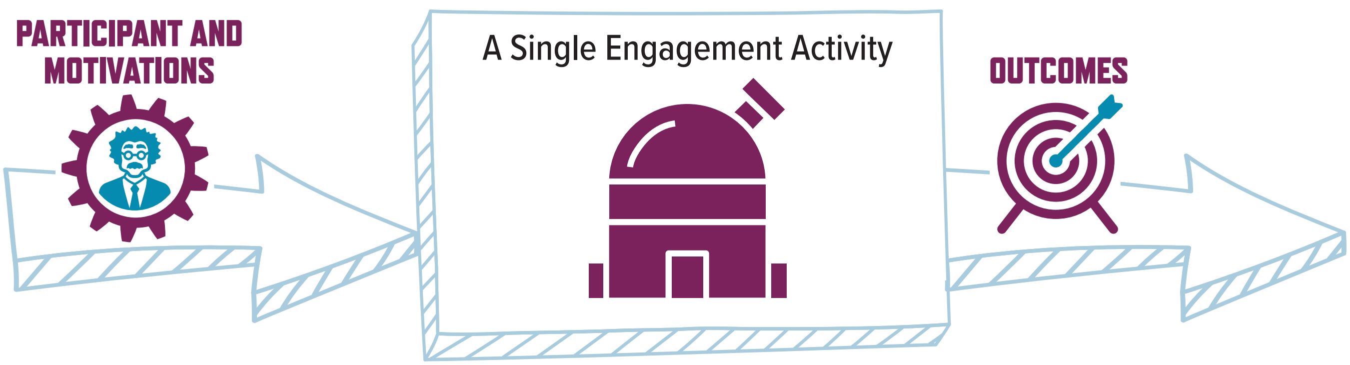


Outcomes of Science Communication and Engagement

Communication and engagement activities can have different outcomes for each of the involved participants. Potential outcomes range from changes in attitude, knowledge, or skills, to a greater curiosity and excitement about science, to better institutional relationships with the local community. For example, a scientist who participates in a science café may develop a greater understanding of the local community's perspective on his or her work, whereas an attendee may become more motivated to click on a news article or watch a YouTube video on that scientific topic. Such outcomes can be immediate and carry direct personal benefits. (For examples of broader societal benefits, see Section 3: Designing Engagement for Specific Impact.)

Categories of Personal Outcomes[15]

- **INTEREST** (such as greater curiosity in science, including scientific careers)
- **KNOWLEDGE AND SKILLS** (such as improved understanding of the scientific process or skill in communicating science)
- **BEHAVIOR** (such as greater capacity for informed decision-making)
- **MOTIVATION** (such as increased likelihood of participating in additional activities)



Evaluation of Outcomes

The social sciences use formal evaluations to assess the outcomes of science communication and engagement activities, but evaluations can be time-consuming and costly and can require additional expertise. Evaluations commonly focus on immediate outcomes, such as a participant's enjoyment or increased interest in a topic. Regardless of the method used, the assessment goals should align with the motivations and desired outcomes of the engagement activity. Evaluation methods include:[16]

* Surveys are the most common.

Understanding Cumulative Impact

An individual's underlying attitudes toward science are the result of the interaction between an unknown number of experiences with science and prior knowledge about science.[18] The long-term, cumulative impacts of experiences and engagement with science are challenging to assess because these experiences do not occur as isolated events and there is limited data on an individual's movement between activities. Further, differences in metrics and methodologies limit researchers' ability to compare existing evaluation data.

ADVANCING EVALUATION: Databases such as informalscience.org/evaluation, maintained by the Center for the Advancement of Informal Science Education, are useful for identifying established assessment tools. The Center for Public Engagement with Science at AAAS (www.aaas.org/pes) advocates for the development of new scales for evaluating outcomes, such as measuring scientists' self-efficacy and outcome expectations.[17]

Highlight: Science Capital Model

The "science capital" model is one example of a comprehensive framework that has been developed to help design activities for a specific long-term outcome. The ASPIRES project, supported by the United Kingdom's Economic and Social Research Council, found that "STEM participation issues are not simply the result of students' not liking science enough."[19] From this study, the concept of science capital was used as a holistic framing device for science engagement focused on boosting perceptions that science is "for me" in people over sixteen years of age. The study identified seven key dimensions of science capital as influencing a young person's attitudes toward science:

1. Science literacy
2. Science-related attitudes, values, and dispositions
3. Science media consumption
4. Participation in out-of-school learning
5. Family science skills and knowledge
6. Knowing people in science-related roles
7. Talking about science in everyday life[20]

Discussion

A core conceptual framework of components that inform the outcomes of science communication and engagement is necessary for having an expanded, interdisciplinary conversation about building the capacity for these activities. Specifically, a shared understanding of the types of participants and the range of sometimes conflicting motivations will further the development of mutually beneficial communication and engagement experiences.

These efforts run parallel to those of organizations such as the Center for Public Engagement with Science and Technology at the American Association for the Advancement of Science, which has developed a "theory of change" for achieving long-term impacts from public engagement activities (see page 11). Ongoing efforts to assess outcomes at science museums, festivals, and other science engagement venues should be supported. Additional social science research is necessary to understand the relationships between these experiences with science in order to identify the activities that support continued participation and build impact. The lessons from such programs must be shared widely among the many communities that contribute to the landscape of science communication and engagement.

As the field develops, it should be recognized that the value of outcomes such as increased curiosity, excitement, and understanding of science, as they relate to changes in behavior and attitudes toward science, are not fully understood. Therefore, outcomes that do not have an immediately visible linear connection to broader societal goals, such as building trust in science about a controversial topic, should not be immediately dismissed. While more research is required, recent data suggest that interest in science and curiosity about science for personal pleasure may produce agreement with the scientific consensus on global warming or support for science funding.[21]

Resources on Science Engagement

Theory of Change for Public Engagement with Science (2016)

A summary and overview of the American Association for the Advancement of Science vision for engagement that supports long-term, aggregate impact. This theory includes a "logic model for public engagement with science."[22]

CAISE's Year in ISE Review (most recently, 2018)

An annual report of notable publications, events, and trends in the informal STEM education community. It includes resources related to making and tinkering, citizen science, media, cyber learning and gaming, public science events, and more.[23]

Learning Science in Informal Environments: People, Places, and Pursuits (2009)

A consensus report from the National Academies of Sciences, Engineering, and Medicine that presents a comprehensive analysis of learning environments and types of learners.[24]

Many Experts, Many Audiences: Public Engagement with Science and Informal Science Education (2009)

A CAISE inquiry report examining how public engagement with science contributes to science education.[25]

Public Engagement Research and Major Approaches (2015)

An annotated bibliography of science engagement literature, commissioned by the American Association for the Advancement of Science Alan I. Leshner Leadership Institute for Public Engagement with Science.[26]

Public Engagement with Science: A Guide to Creating Conversations among Publics and Scientists for Mutual Learning and Societal Decision-Making (2017)

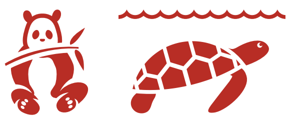
"A guide to creating conversations among publics and scientists for mutual learning and societal decision-making" from the Museum of Science in Boston. The guide includes key questions for planning, designing, and evaluating engagement activities, with examples and descriptions of concepts throughout.[27]

Typology for Public Engagement with Science: A Conceptual Framework for Public Engagement Involving Scientists (2016)

A conceptual framework for public engagement with science from the Center for Research on Lifelong STEM Learning at Oregon State University. The typology provides an overview of the key elements of science engagement and example opportunities targeted toward scientists and practitioners.[28]

Visiting Science

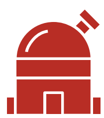
Informal science education refers to experiences that take place outside of a formal classroom setting, including at museums, zoos, aquariums, planetariums, national parks, and botanical gardens.[29] These institutions are visited by millions of people each year, including nearly 60 percent of U.S. adults—comparable to public library attendance (see graph below). While not all national parks and botanical gardens feature science, scientific programming can be incorporated into the experience, such as through location-based climate change programming.[30] As described in the previous section, visitors interpret the knowledge gained through these experiences differently depending on their background, previous knowledge, and past experience.



ZOOS AND AQUARIUMS

232 accredited zoos and aquariums

195 MILLION annual visits[31]



SCIENCE CENTERS AND MUSEUMS

401 U.S. members of the Association of Science and Technology Centers

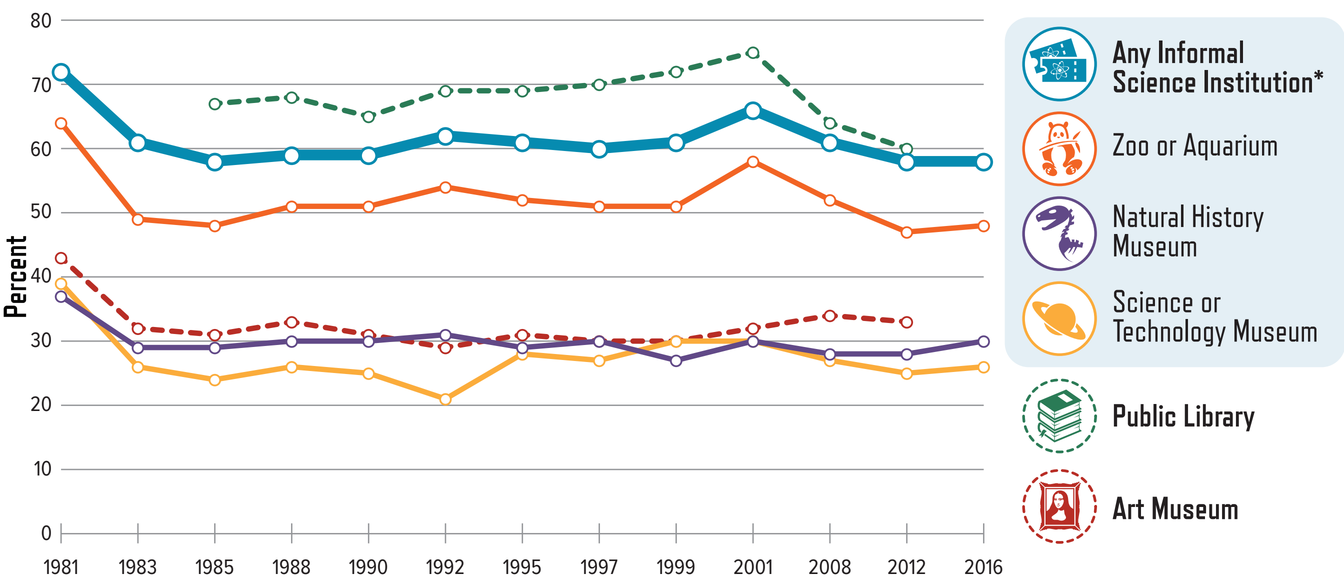
~80 MILLION annual visits[32]

NATIONAL PARKS

60 U.S. National Parks

331 MILLION annual visits[33]

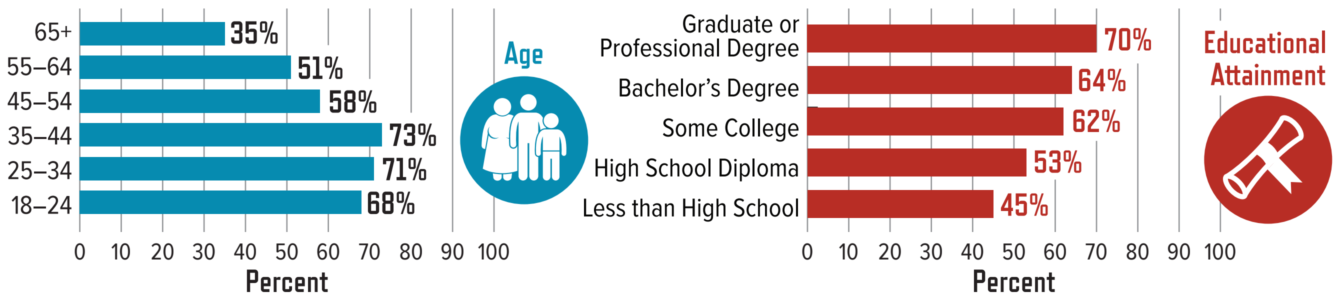
Percentage of U.S. Adults, Age 18 or Older, Who Reported Visiting These Institutions at Least Once During the Last 12 Months:



* Visited a zoo or aquarium, natural history museum, or science or technology museum at least once.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1981–2001); and NORC at the University of Chicago, General Social Survey (2008–2016).

Percentage of Respondents Who Reported Visiting Any Informal Science Institution at Least Once During the Last 12 Months:



SOURCE: NORC at the University of Chicago, General Social Survey (2016).

In addition to designing programming to appeal to a demographically diverse audience, informal science centers also must consider the wide range of motivations that draw people to attend. Individuals do not necessarily visit science centers with the sole intention of learning about science. Indeed, for many people, the desire for social experiences and entertainment may be the primary reason for attending. When assessing the needs of the audience for exhibits and programs, therefore, it is crucial that curators, facilitators, and other practitioners start with an understanding of visitors' motivations, as well as their demographic profiles.

In the Case of Science Museum Audiences, for Example, Motivations Can Include:[34]

- **CURIOSITY**
- Desire for **SOCIAL ACTIVITY**
- **PERSONAL INTEREST** in satisfying a specific content-related objective
- Perception that it is an **IMPORTANT** institution to visit
- Desire for a contemplative, spiritual, restorative **EXPERIENCE**
- Perception that it speaks to **HERITAGE** and/or identity

The Role of Informal Science Venues in the STEM Learning Ecosystem

STEM learning ecosystems are the cross-sector combination of formal and informal science education opportunities ranging from after-school programs to podcasts to informal science venues.[35] In addition to providing hands-on learning experiences, these science venues can support community STEM needs by providing curriculum and teacher training or supporting community activities such as public events and forums. Facilitating connections within a STEM ecosystem can be challenging in rural areas that lack informal science institutions and organizations.[36]

Attending Science Events

One popular venue for science communication and engagement is the stand-alone science event, including science festivals and science cafés. Initiatives that incorporate science programming into nontraditional science venues—music festivals, sporting events, and so on—such as Guerilla Science or "Just Add Science," provide additional opportunities to engage with scientific content.[37]

Science Cafés

Science cafés, such as Science Pub, Science by the Pint, Science on Tap, and Café Sci, are events held in an informal community gathering place (such as pubs or libraries) that allow for dynamic two-way interactions with scientists. Organizations that produce science events for an adult audience include Nerd Nite, Taste of Science, and Pint of Science. The NOVA directory sciencecafes.org includes more than four hundred unique entries.

Science Festivals

Science festivals are collaborative annual or biennial event series that celebrate and engage local communities in STEM. The Science Festival Alliance (SFA) formed to establish and sustain such events. In 2017 alone, an estimated 19,892 STEM practitioners at forty-seven SFA festivals, representing a total of 4,671 events, hosted more than two million people across the United States.[38] The four 2017 science festivals highlighted below demonstrate the wide variability in format and scope of science festivals:

STATEWIDE SCIENCE FESTIVAL

2017 North Carolina Science Festival

A science event located within a **30-MINUTE DRIVE** of every resident in the state.

850 EVENTS in **17 DAYS** across the region, featuring **377** collaborating **ORGANIZATIONS**.

METRO-REGION SCIENCE FESTIVAL

2017 Atlanta Science Festival

A cultural celebration of the **REGION'S** science identity.

111 EVENTS in **11 DAYS** across the region, featuring **70** collaborating **ORGANIZATIONS**.

EMBEDDED SCIENCE FESTIVAL PAVILION

2017 Science Learning Tent at the Arlee Celebration and Elmo Standing Arrow Powwow Activities woven into powwows on Montana's Flathead Reservation

36 EVENTS in **3 DAYS** across the region, featuring **12** collaborating **ORGANIZATIONS**.

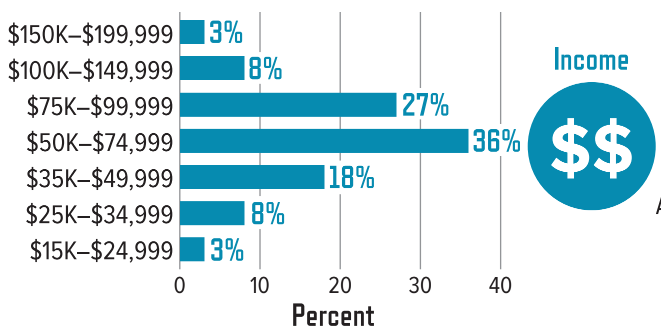
COMMUNITY-BASED SCIENCE FESTIVAL

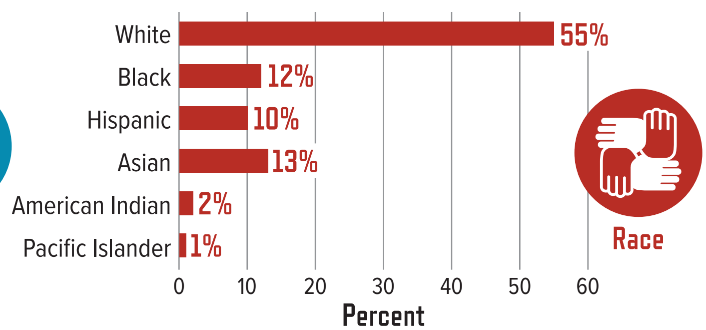
2017 Youngstown Regional Science and Technology Festival

A celebration of the science community in this small(er) Ohio city. **28 EVENTS** in **1 DAY**, featuring **40** collaborating **ORGANIZATIONS**.

EvalFest is an NSF-funded community of practice that develops evaluation approaches for understanding and explaining the impact of science festivals.[39] Evalfest data from 2017 show that while many festival attendees came with their families, 33 percent of participants did not attend with children. Although the demographics of the attendees vary among festivals, on a national scale these data reveal a demographically diverse audience. Evalfest notes that these data were collected primarily at family friendly expos and may not be representative of the entirety of festival activity.

Demographics of Festival Attendees:

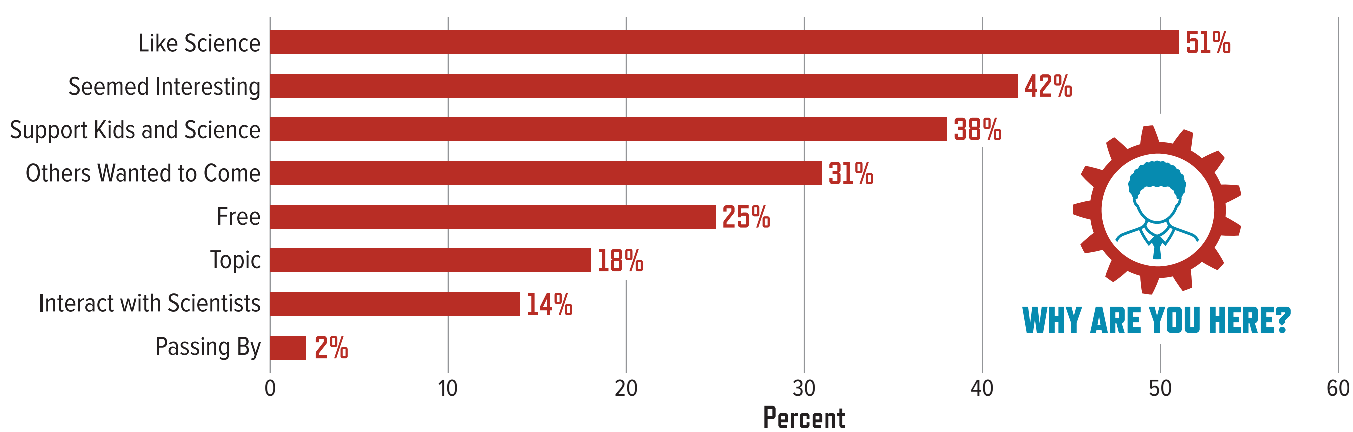




SOURCE: Science Festival Alliance, *2017 Annual Report* (Cambridge, Mass.: Science Festival Alliance, 2017).

As shown below, common motivations for attending science festivals cited by EvalFest survey respondents included liking science and interest in science. Data also suggest that festivals have positive effects on respondents' perceptions of STEM in their communities: 75 percent of attendees reported that a festival had "quite a bit" or a "great deal" of impact on their understanding of the advances their region or state was making in STEM (data not shown).

Motivations for Attending a Science Festival, 2016–2017:



SOURCE: Science Festival Alliance, *2017 Annual Report* (Cambridge, Mass.: Science Festival Alliance, 2017).

Participating in Science

Citizen science is an example of public participation in STEM research. *Citizen science* generally refers to public (individual or community) contributions to large-scale scientific research projects, either in person and/or online. In addition to furthering scientific investigation, citizen science projects support educational and social objectives for the participants. These projects are commonly discussed on social media using the hashtags #CitizenScience and #CitizenScientists. Makerspaces and online platforms can support citizen science projects by providing centralized locations for sharing ideas, equipment, and other resources.

Percentage of U.S. Adults Who Say They Have Ever . . .

Made observations or collected data samples as part of a science research project

14%

Contributed to science-related online crowdsourcing activity

3%

Participated in a maker movement to develop new tech or in a hack-a-thon

2%

SOURCE: Cary Funk, Jeffrey Gottfried, and Amy Mitchell, *Science News and Information Today* (Washington, D.C.: Pew Research Center, 2017; survey conducted May 30–June 12, 2017).

Citizen Science Databases

Host Website or Database	Description	Project Example
SciStarter.com @SciStarter	Searchable database of more than 1,600 projects worldwide; mostly volunteers	Flu Near You: tracks influenza in real time across the United States
Zooniverse.org @the_zooniverse	Online platform hosting a suite of classification, annotation, and transcription projects; volunteers and practitioners	Galaxy Zoo: morphologically classifies large numbers of galaxies
Citizenscience.gov @FedCitSci	Website and project portal for government-led citizen science projects; mostly government researchers/practitioners	Did You Feel It?: gathers real-time information about earthquakes as they happen
CitSci.org @CitSci	Platform to support development of citizen science projects through tool and resource sharing; mostly practitioners	Southwest Exotic Mapping Program: collects and disseminates information on the distribution of invasive exotic plant species
Birds.cornell.edu @CornellBirds	Portal to bird-related citizen science projects developed by Cornell Lab of Ornithology; mostly volunteers	eBird: contributes to a global online checklist project of bird abundance and distribution

Citizen scientists are motivated by everything from curiosity to general interest in science to the desire to contribute to research.[40] According to a 2018 National Academies report, for citizen science activities, "science learning outcomes are strongly related to the motivations, interests, and identities of learners."[41] The outcomes of citizen science activities also vary with the project setting and nature of the activity. A majority of the topics in recently published articles mentioning citizen science are drawn from the biological sciences, astronomy, and environmental science (see data below). Some citizen science projects have been shown to raise awareness of new research, promote greater understanding of science, encourage continued participation in engagement activities, and increase monitoring of local issues.[42]

In a 2017 Pew Research Center survey, **18 PERCENT OF U.S. ADULTS** said they have a "**SCIENCE-RELATED HOBBY**, interest or activity they do outside of work."[43]
See pages 21–25 for more examples of "Science in Everyday Life."

Activities

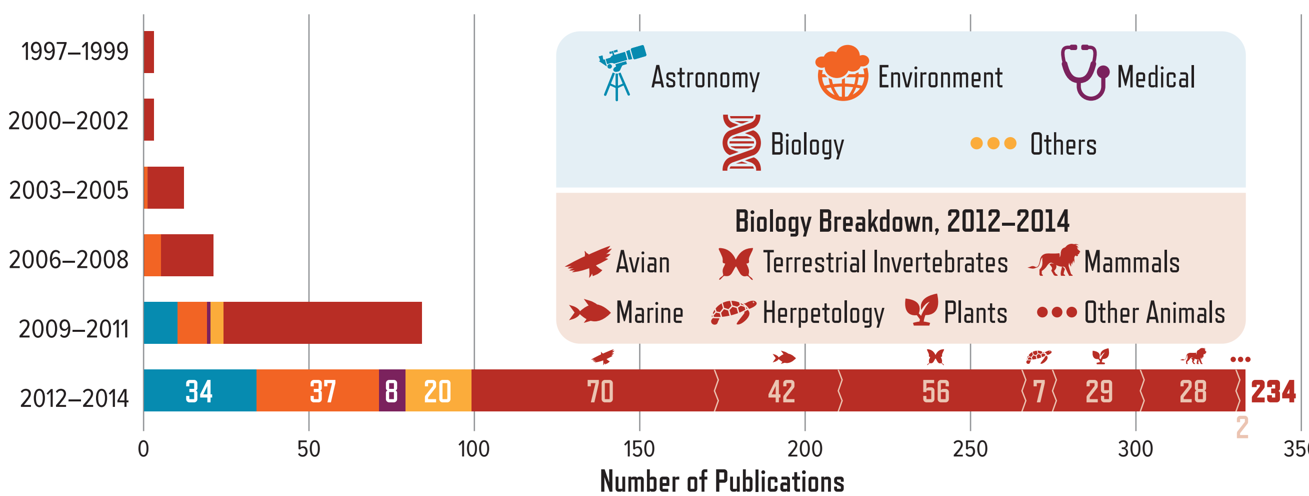
DATA COLLECTION

DATA PROCESSING


CURRICULUM-BASED PROJECTS


COMMUNITY SCIENCE

Disciplines or Topics of Citizen Science Projects Mentioned in Published Articles



SOURCE: Ria Follett and Vladimir Strezov, "An Analysis of Citizen Science Based Research: Usage and Publication Patterns," *PLOS One* 10 (11) (2015): e0143687.

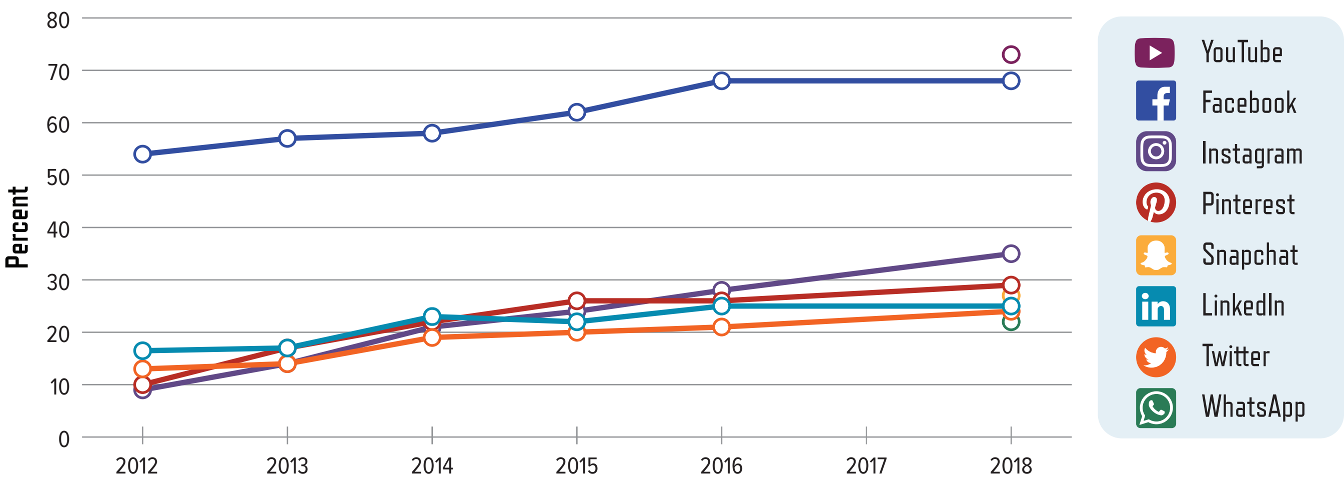
Engaging with Science Online

Social Media

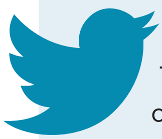
Social media platforms such as YouTube, Facebook, Instagram, Twitter, and Snapchat provide opportunities for science communication and engagement. Over the last five years, social media use has been dynamic (see graph below). Moreover, use of these platforms varies significantly based on the age of the user. Majorities of adults use Facebook and YouTube.[44] Instagram and Snapchat are more popular among eighteen-to-twenty-four-year-olds than they are among older adults.[45]

Well-known institutions and media outlets are more likely to have a larger presence on social media. For example, at the time of the study in June 2017, National Geographic, Discovery, and Animal Planet had 44, 39, and 20 million Facebook followers, respectively.[46] Other Facebook pages, such as IFLScience, have become popular (25.6 million followers in June 2017) without any institutional affiliation.

Percentage of U.S. Adults, Ages 18 and Over, Who Say They Use the Following Social Media Sites/Apps



NOTE: Data depict general social media use. **SOURCE:** Aaron Smith and Monica Anderson, *Social Media Use in 2018* (Washington, D.C.: Pew Research Center, March 2018; survey conducted January 3–10, 2018).



Science on Twitter

Twitter allows for rapid, real-time communication. As a platform, it can be used for both one-way information sharing (posting a hyperlink) and two-way or group dialogue (mentions).[47] Twitter enables users to live-tweet conferences, share papers, build communities, and disseminate science news, making it a lively forum for science engagement. But while Twitter can be a venue for public engagement, scientists' Twitter audiences mostly comprise other scientists—up until a certain threshold. A recent study found that scientists with over one thousand followers reach a more diverse audience, including people and organizations outside of the scientific community.[48]

Digital Storytelling

As a science communication tool, storytelling can paint a vivid picture of scientific discovery or personal experiences with science.[49] Although storytelling can be incorporated into any form of in-person science communication and engagement, online platforms such as blogs and podcasts provide newer opportunities for science storytelling.

Podcasts

Podcasts use a downloadable audio format to provide an informal, on-demand source of information and entertainment. Storytelling is a common science communication strategy used on podcasts such as Radiolab and Story Collider. According to a recent study, the number of science podcasts increased at an exponential rate from 2010 to 2018.[50]

MOST POPULAR TOPICS

GENERAL SCIENCE

PHYSICS and **ASTRONOMY**

BIOLOGY

HOSTS

65 PERCENT of science podcasts are hosted by **SCIENTISTS**,

10 PERCENT by **MEDIA PROFESSIONALS**.

TARGET AUDIENCE

77 PERCENT of science podcasts target a **PUBLIC** audience,

16 PERCENT target **SPECIALISTS**.[51]

Science Blogs

Science blogs do many things: from discussing the latest scientific research to analyzing the social impact of a new discovery to sharing a personal story about a day in the life of a researcher. Online comment sections provide writers with opportunities for extended dialogue with their audience. In addition to independent blogs, there are also science blogs published by major news media websites and other professional networks. A 2017 analysis of the profiles of science blog readers found that:[52]

AUDIENCE

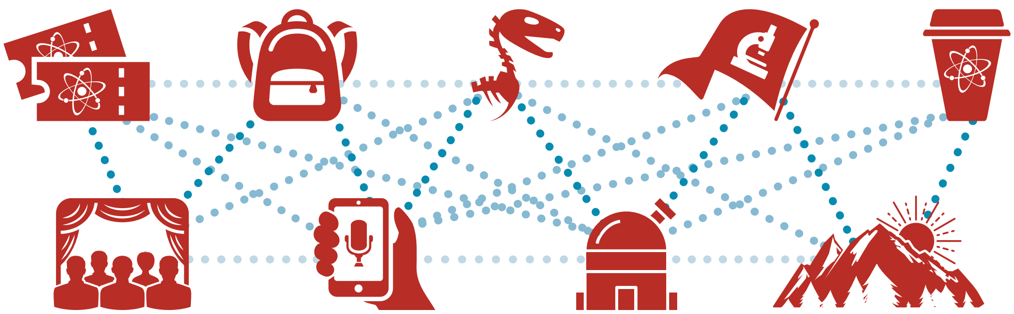
largely consists of consumers of science media with a **HIGH LEVEL** of scientific knowledge.

USER MOTIVATIONS

include **CURIOSITY**, information/desire to stay **CURRENT**, **ENTERTAINMENT**, and **COMMUNITY**.

Discussion

Whether it is an interest in local conservation efforts that leads a high school student to become a citizen scientist, or a desire to stay current that causes a researcher to follow a science blog, or a shared interest in STEM that brings a group of friends to a science festival, understanding audience motivations for participating in particular activities is necessary for identifying the potential outcomes of engagement. Approaches to science communication and engagement that build connections to previous experiences with science and provide opportunities for continued engagement have the potential for long-term effects, such as a higher curiosity about science, different perceptions of science, or behavioral changes based on scientific information.



Engagement around a Shared Event

Opportunities for engagement can arise from current events. For instance, the August 21, 2017, total solar eclipse was estimated to have been viewed directly or electronically by 88 percent of Americans.[53] In a subsequent survey, a majority of eclipse viewers found the experience of watching the eclipse to be enjoyable and educational. In the months prior, people reported discussing the eclipse with friends, coworkers, and family and reading stories in newspapers and magazines. Participation in eclipse activities included:

ATTENDING ORGANIZED EVENTS
approximately **4.6 MILLION** people

SHARING PERSONAL EXPERIENCES ON SOCIAL MEDIA
ONE in **FIVE** viewers

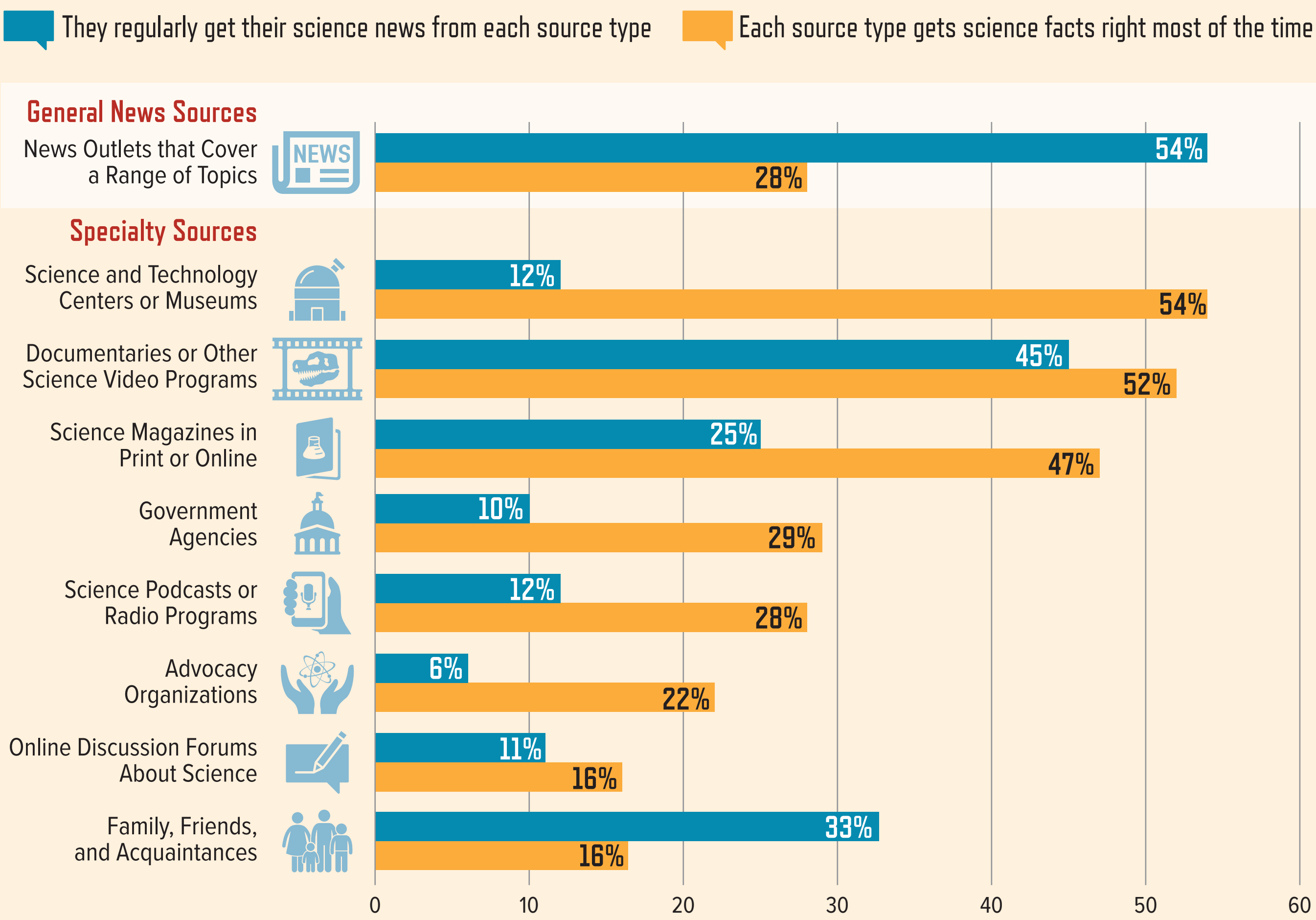
CONTRIBUTING TO CITIZEN SCIENCE PROJECTS[54]

SPECIAL SECTION:
SCIENCE IN EVERYDAY LIFE

As noted in *Perceptions of Science in America*, more research is needed on how "various forms of news media, social media, and entertainment" influence trust in science. Despite the need for additional research, the everyday ways people interact with science can shape attitudes or improve understanding of science either on their own or by providing opportunities for extended dialogue or concomitant engagement experiences. This section highlights data from the Pew Research Center report on how people 1) obtain **science news**; 2) see **science news on social media**; and 3) watch **science-related entertainment**.

General News Outlets are a Common Source of Science News

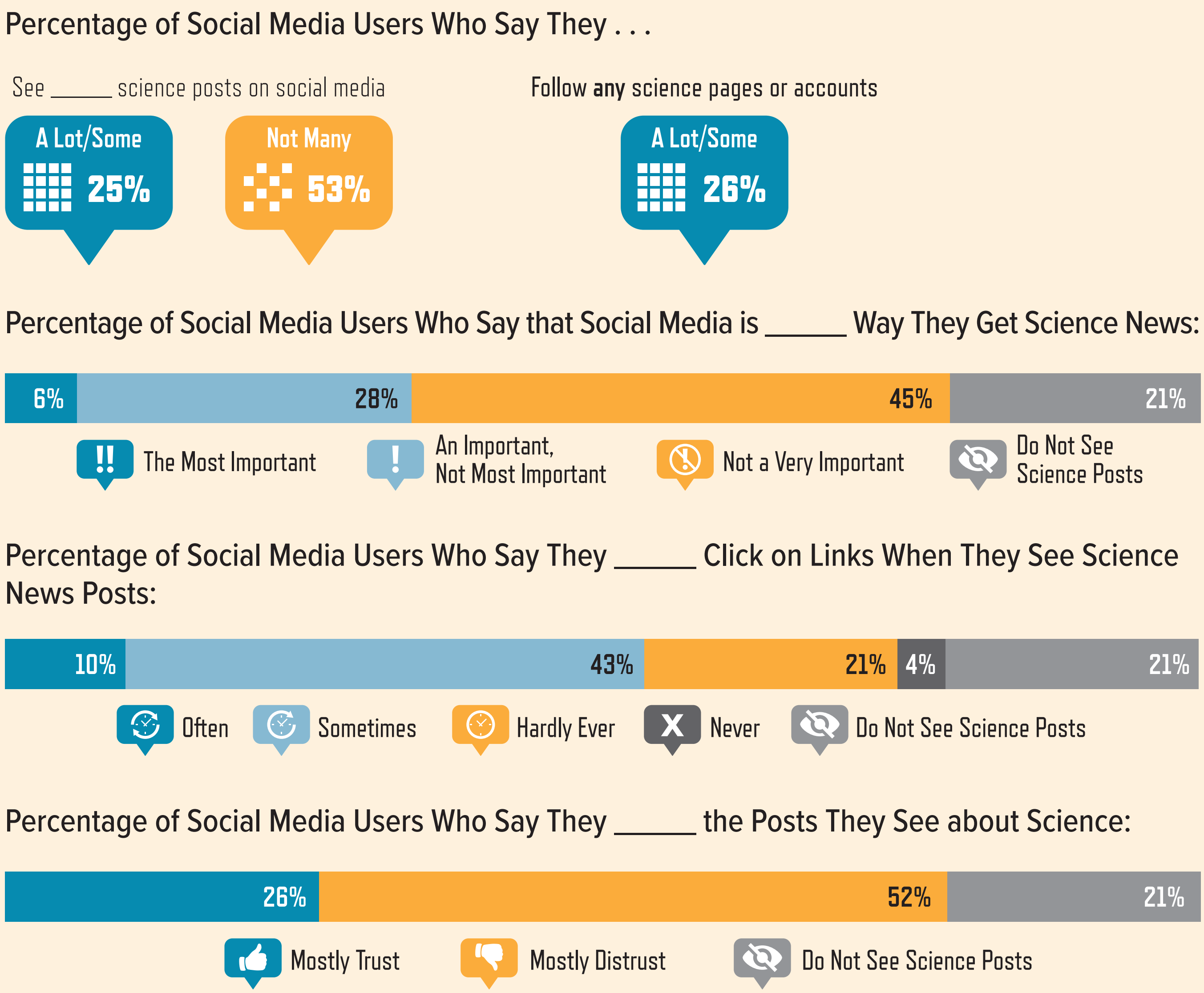
Percentage of U.S. Adults Who Say . . .



NOTE: "Most of the time" combines those who said "almost all" or "more than half" of the time. Respondents who gave other responses on each question or who did not give an answer are not shown. Other source types rated are not shown.
MARGIN OF ERROR: +/– 1.6. **SOURCE:** Cary Funk, Jeffrey Gottfried, and Amy Mitchell, *Science News and Information Today* (Washington, D.C.: Pew Research Center, 2017; survey conducted May 30–June 12, 2017).

Among science-related topics, Americans are most interested in news on "health" and "food and nutrition." A 2017 Pew survey found that more Americans say they regularly get science news from a source that covers general news than from sources that specialize in science topics.[55] However, people are more likely to believe that science-specific information sources, such as science museums or documentaries, get their science facts right most of the time. These data also agree with the National Awareness, Attitudes, and Usage study findings that science museums, zoos, aquariums, and natural history museums are more highly trusted compared with nongovernmental organizations (NGOs), state and federal agencies, and daily newspapers.[56]

Science Posts are Commonly Seen on Social Media

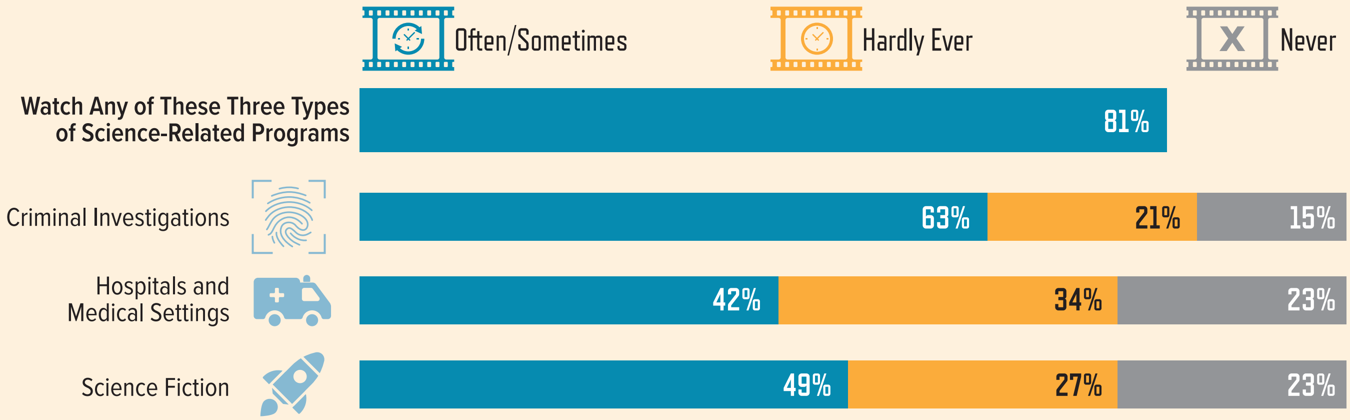


MARGIN OF ERROR: +/– 1.6. **SOURCE:** Cary Funk, Jeffrey Gottfried, and Amy Mitchell, *Science News and Information Today* (Washington, D.C.: Pew Research Center, 2017; survey conducted May 30–June 12, 2017).

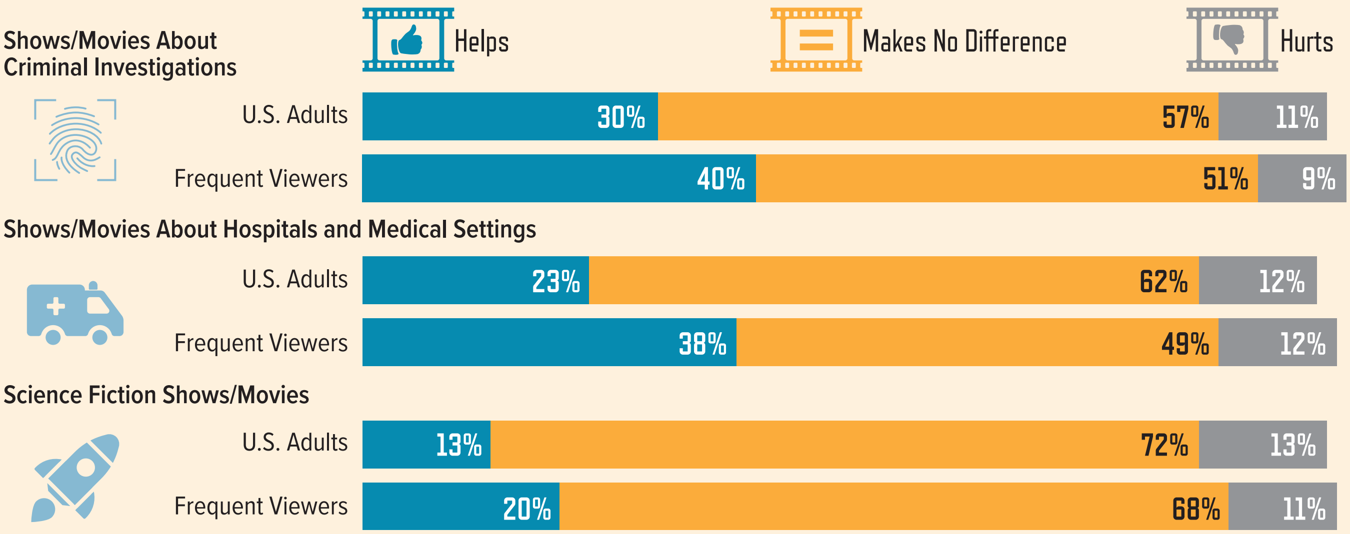
The emergence and growth of social media have caused significant changes in how news and information are shared and experienced. In 2018, 69 percent of U.S. adults reported using at least one social media platform.[57] In a separate survey on science news sources, the Pew Research Center found that 26 percent of social media users specifically followed at least one science page or account, whereas 79 percent had seen posts featuring scientific content. Among social media users, 33 percent consider social media to be an important source of science news, while 52 percent mostly distrust the posts they see about science. The most commonly seen science-related posts on social media were on "strange or weird scientific findings" or "new discoveries."[58]

A Majority of Americans Watch Science-Related Entertainment

Percentage of U.S. Adults Who Say They Watch Shows and Movies of Each Type . . .



Percentage of U.S. Adults Who Say Each of the Following Types of Science Shows and Movies **Helps**/**Makes No Difference** to/**Hurts** Their Understanding of Science, Technology, and Medicine:



MARGIN OF ERROR: +/– 1.6. **SOURCE:** Cary Funk, Jeffrey Gottfried, and Amy Mitchell, *Science News and Information Today* (Washington, D.C.: Pew Research Center, September 20, 2017; survey conducted May 30–June 12, 2017).

Americans across demographic groups commonly experience science content through entertainment media. A study of prime-time network programming from 2000 to 2008 found "good" portrayals of scientists to be more common than "bad" depictions, although only about 1 percent of the characters in these shows were characterized as a scientist.[59] To date, academic studies on the influence of science in popular culture have focused more on television and movies than games, comic books, or digital media.[60] Additional research is therefore necessary to understand fully the impact of popular-culture depictions of science and scientists.

Discussion and Research Considerations

People are regularly exposed to scientific concepts, new discoveries, and technological advancements as part of general news, social media, and entertainment. While there has been some research on this subject, this landscape is rapidly evolving. More research is needed on the impact of these developing sources and effective approaches for ensuring accuracy of scientific content. Moreover, continued research into the impact of negative narratives about science and effective approaches to addressing these narratives is necessary.

Evolving Information Sources

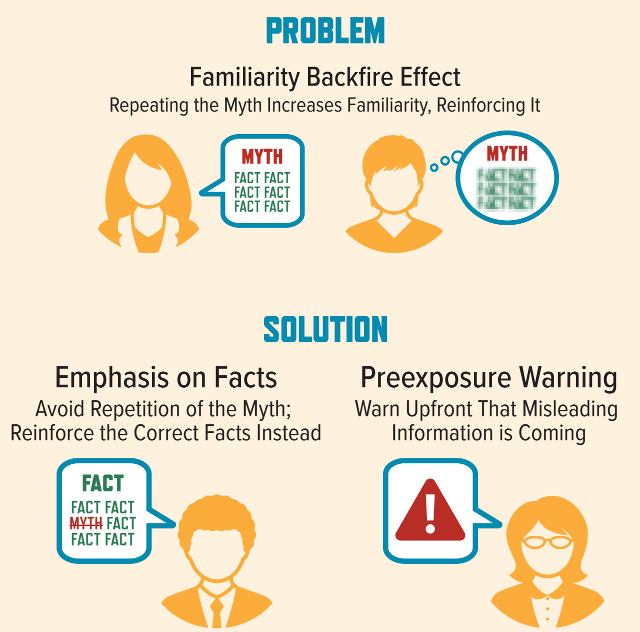
- What is the role of social media in disseminating scientific information and spreading misinformation?
- What role do online databases play in shaping perceptions and understanding of science? How accurate is the scientific information?
- How much scientific content originates from outside the United States? How does access to international science influence perceptions of science in the United States?
- What is the responsibility of search engines to vet information and provide guidance on which websites are the most trustworthy?

The Implications of Encountering "Bad Science"

- How do stories of fraudulent research influence attitudes toward science? What is the influence of stories on conflicts of interest on trust in science? What are the effects of these stories on both the specific field of research and general attitudes toward science?
- How should the scientific community respond to cases of bad science? What are the best practices for discussing these stories in the media?
- What are the long-term impacts of narratives such as "science is broken"? How does the framing of scientific discoveries influence perceptions of the scientific process and advancements?

Research Highlight: Applying the Cognitive Sciences to Communication

The field of cognitive sciences can provide insight into effective visual and verbal communication by studying how information is processed or spread within society. For example, data visualization studies can reveal areas of misunderstanding in particular presentations of quantitative information such as a connected scatter plot or dual-axis line graph.[61] Of particular importance to the scientific community are recommendations into correcting misinformation on topics such as vaccines, climate change, and genetically modified organisms, on which the scientific consensus has been rejected by different populations of the public.[62]



SOURCE: Adapted from Stephan Lewandowsky et al., "Misinformation and Its Correction: Continued Influence and Successful Debiasing," *Psychological Science in the Public Interest* 13 (3) (2012).

Science Engagement for the Benefit of Society

Sections 1 and 2 highlighted some of the fundamental components that inform the design of science communication and engagement activities. As previously discussed, participants in science communication and engagement activities may experience changes in interest, skill, behavior, or motivation. While these outcomes are not necessarily intentional on the part of the organizers of the activity, they are an important component of the value of science communication and engagement.

Moreover, it is common for the funders and facilitators of science communication and engagement to identify desired outcomes based on broader societal goals, such as greater diversity in the STEM workforce or motivating a local community to address a local conservation issue. The following section provides examples of science communication and engagement activities that seek to achieve specific impacts in the following areas:

- **FOSTERING COMMUNITY ENGAGEMENT WITH SCIENCE**
- **BUILDING TRUST IN INFORMATION ON CONTROVERSIAL TOPICS**
- **BROADENING PARTICIPATION IN STEM FIELDS AND ACTIVITIES**

This list is not exhaustive; it does not represent all of the ways science communication and engagement can be influential. Similarly, the specific examples of activities and networks highlighted in this section are not meant to convey a standardized approach, but are used to illustrate the different ways science communication and engagement seek to achieve these goals.

Fostering Community Engagement with Science

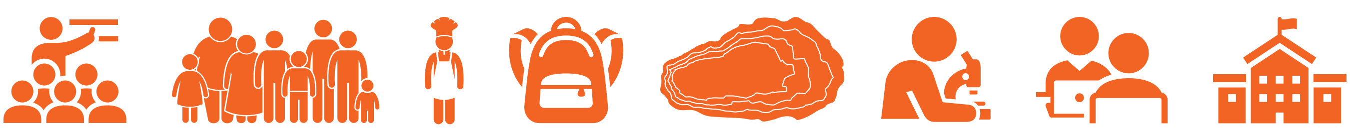
Potential approaches to community engagement activities are as varied as their stakeholders, goals, and outcomes. Community engagement activities can range from community-stakeholder engagement and project co-creation as part of global health research, to community participation in research on local environmental change, to efforts to network effectively and engage both professional affinity groups and public constituencies. The **Billion Oyster Project** is an example of a collaborative project based around a local environmental restoration initiative. Community engagement approaches also have the potential to strengthen scientific studies or avoid harmful outcomes when executed effectively within the appropriate contexts.[63] The push for community and stakeholder inclusion in the decision-making on the topic of **gene drives** is one example of this approach.

A Multi-Institutional Collaborative Project: The Billion Oyster Project

The Billion Oyster Project (BOP) is an education and restoration initiative with the goal of restoring one billion live oysters to New York Harbor by 2030 to improve the water quality and health of the ecosystem. This environmental citizen science project includes both a formal middle school curriculum and informal after-school activities. As part of the project-based learning, students grow new oysters on discarded oyster shells donated by local restaurants. BOP also plans to create local aquarium exhibits for the purpose of increasing New Yorkers' "understanding of and personal connection to their local marine ecosystems."[64] BOP has also participated in family festivals, collaborated with exhibitors at arts festivals, and hosted science events.[65]

Engaging Communities on Scientific Research: Gene Drives

Gene drives are a form of genetic engineering that increases the likelihood that a beneficial genetic allele will propagate throughout a population, such as by introducing pathogen resistance in an animal host population. As a result, field trials of gene drives have the potential to impact entire ecosystems. A 2016 National Academies of Sciences, Engineering, and Medicine report on advancing the science of gene drives emphasizes engaging communities, stakeholders, and publics as "critical for successful decision making regarding research, development, and potential release of gene drive technologies."[66] Researchers at the Massachusetts Institute of Technology have directly engaged communities on the islands of Nantucket and Martha's Vineyard in Massachusetts about genetic engineering approaches to vaccinating the local mice population against Lyme disease. In the early stages of the research, evolutionary biologists attended local town halls and established governance plans with residents. During these community engagement efforts, local citizens raised concerns about the use of gene drives, but have remained open to the potential use of other genetic engineering approaches.[67] While a gene drive approach is no longer being considered for vaccinating the island mice against Lyme disease, scientists have continued to develop solutions in partnership with local communities. Researchers are now working to vaccinate the mice population by using immunity based on mouse-derived anti-Lyme antibody DNA.[68]



BILLION OYSTER PROJECT BY THE NUMBERS

Since 2014, BOP has reached more than **100** schools, **70** restaurants, **9,000** volunteers, and **6,000** students, and has grown **26 MILLION** new oysters.

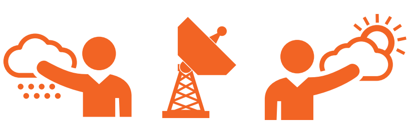
Building Trust in Information on Controversial Topics

As discussed in *Perceptions of Science in America*, only a small minority of scientific topics are controversial or politically polarized, yet these issues threaten to undermine confidence in scientific research and reduce society's capacity to develop appropriate public policy. Scientific topics that have generated controversy in public discourse, such as climate change, vaccines, genetically modified organisms (GMOs), and evolution, require specialized approaches to debunking misinformation.[69] Science communication and engagement on these issues should use evidence-based methods, dialogue, and trusted messengers.

Climate Change

Trusted Sources on Climate Change: *Climate Matters*

Climate Matters is a climate communication resource program for American broadcast meteorologists, which on a weekly basis provides localized data and analyses and TV-ready multimedia. The goal of the program is to reduce the barriers to reporting on the impact of climate change in local communities. Meteorologists were identified as effective climate change educators because of their regular access to a sizable audience for whom they are trusted sources of information.[70] Moreover, this approach allows for more effective experience-based learning through which information can be communicated in the context of local weather events and will be more likely to influence beliefs and behavior.



CLIMATE MATTERS

As of **JANUARY 2019**,
MORE THAN 500 local weathercasters
were participating in the program[71]

Human Evolution

Local Dialogue about Human Evolution: *Smithsonian Institution's Traveling Exhibit, Exploring Human Origins: What Does It Mean To Be Human?*

This traveling exhibit, based on the Smithsonian Institution's David H. Koch Hall of Human Origins exhibit in partnership with the American Library Association, visited nineteen public libraries between 2015 and 2017. The project's main goal was to encourage conversation about scientific research, specifically on human evolution, within each community. Ten of the nineteen libraries were located in regions of the United States where "evolution might still be a contentious subject."[72] This conversational approach encouraged local community members to speak with one another about science in public libraries and town-hall meetings, to meet scientists (often for the first time), and to model helpful dialogue about scientific findings and public perceptions of science. The programming at each library was tailored to the local community based on feedback from a panel of "community members from diverse religious, educational, civic, scientific, and other backgrounds."[73] The exhibit's programming also included educator workshops and a clergy tour that highlighted resources on the subject of evolution and the intersection of science and religious faith. According to an external evaluation of this project, an enthusiastic and respectful approach to the scientific findings concerning human evolution predominated in all nineteen communities.[74] Even where large numbers of participants expressed strong initial doubts about the subject, 75–86 percent of people who later attended the exhibit or related public events stated that the scientific research "enriched their understanding about what it means to be human."

Broadening Participation in STEM Fields and Activities

Experiences with science can be designed with the expressed goal of lowering barriers to participation of underrepresented groups in STEM activities. A task force of informal STEM education and science communication professionals convened by CAISE has emphasized that efforts should not focus solely on career or workforce goals as outcomes of participation—and that there are other worthy and important goals, such as creating "lives empowered by STEM literacy, knowledge, and identity.[75] Communication and engagement scholars and practitioners are therefore increasingly considering issues of diversity and inclusivity with respect to the facilitators, target audiences, and approach. The NSF initiative cited below is an example of a comprehensive approach focused on the goal of broadening participation, whereas the second example illustrates the importance of representations of science in popular culture.

National Science Foundation

Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES)

INCLUDES is an NSF initiative focused on improving access to STEM education and career pathways so that the STEM workforce "reflects the diversity of the nation."[76] This comprehensive, multiyear program includes funding for pilot programs and networks organized around shared goals and metrics within a collaborative infrastructure. The pilot grants from this project include efforts to "provide STEM engagement for students and communities" and addressing "students' STEM identity, attitudes and motivation." For example, the Alliance to Strengthen the STEM Tapestry (ASSiST) is an INCLUDES-supported project that focuses on STEM-disenfranchised populations who "feel alienated, marginalized or incapable of participating in STEM."[77] The ASSiST project focuses specifically on providing STEM engagement activities, including ecological restoration and storytelling, to adults recently released from incarceration, youth who were previously in juvenile custody, and refugee youth. These approaches were built on insights gleaned from previous approaches to bring science to the incarcerated.[78]

Depiction of Science in Popular Culture

People commonly encounter and experience science through popular culture and entertainment (see Special Section: Science in Everyday Life). Entertainment media such as movies, television, online videos, and video games therefore present an important opportunity to shape cultural expectations regarding who can and should pursue scientific careers.[79] Efforts to encourage a more diverse representation of scientists in entertainment can have a ripple effect in which additional conversations, events, and programming are established to expand these depictions. The 2016 film drama *Hidden Figures,* based on a nonfiction book of the same title written by Margot Lee Shetterly, is one recent example. *Hidden Figures* tells the story of three African-American mathematicians—Katherine Johnson, Dorothy Vaughan, and Mary Jackson—who made significant contributions to NASA during the space race. In addition to directly amplifying the book's story of these accomplished women in STEM professions, the release of the film fostered myriad additional activities focused on the untold stories of women in STEM fields, including film screenings, outreach programs, and online discussions. The popular overseas screenings and discussions of *Hidden Figures* organized by local U.S. embassies and consulates are one high-profile example. The popularity of screenings in eighty different countries led the U.S. Department of State to create the #HiddenNoMore cultural exchange program.[80] This program brought forty-eight global women leaders in STEM together in the United States for three weeks to develop best practices for recruiting and training underrepresented groups.

Conclusion

This report highlights the breadth of opportunities for people to encounter science, from participating in research to reading science news, while providing an overview of the nuances and complexities that inform the practice of effective science communication and engagement. An understanding of who participates in science communication and engagement, their motivations for participating, and approaches for measuring outcomes should be integrated into the design of communication and outreach efforts. A growing awareness of established resources and academic literature on these activities would increase the potential for impact and reduce efforts that attempt to reinvent the wheel.

Comprehensive frameworks are being used to understand how people's attitudes, media consumption, and encounters with science inform their attitudes and behavior toward science. Expanded evaluation, data-sharing, and social science research are necessary to understand fully the collective impact of science communication and engagement efforts. Moreover, the significant changes in the way people access information and entertainment since the start of the twenty-first century, such as the increasingly global nature of information-sharing, must be considered as part of any research effort.

Endnotes

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APPENDIX A: Public Face of Science Steering Committee and Staff

Steering Committee

Richard A. Meserve, *Chair*, Senior Of Counsel, Covington & Burling LLP; President Emeritus, Carnegie Institution for Science

Emilio Bizzi, Institute Professor, Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology

Geoffrey Cowan, University Professor, Annenberg Family Chair in Communication Leadership, and Director of the Center on Communication Leadership & Policy, University of Southern California

Ellen Futter, President, The American Museum of Natural History

Sylvester James Gates, Jr., Ford Foundation Professor of Physics and Affiliate Professor of Mathematics, Brown University

Robert M. Hauser, Executive Officer, American Philosophical Society; Vilas Research Professor and Samuel Stouffer Professor of Sociology, Emeritus, University of Wisconsin-Madison

Rush D. Holt, Jr., Chief Executive Officer and Executive Publisher of *Science*, American Association for the Advancement of Science

Kathleen Hall Jamieson, Elizabeth Ware Packard Professor of Communication, University of Pennsylvania's Annenberg School for Communication; Walter and Leonore Annenberg Director of the Annenberg Public Policy Center, University of Pennsylvania; Program Director of the Annenberg Foundation Trust at Sunnylands

Venkatesh Narayanamurti, Benjamin Peirce Research Professor of Technology and Public Policy, Harvard University

Nora S. Newcombe, Laura H. Carnell Professor of Psychology, Temple University

Kenneth Prewitt, Carnegie Professor, Special Advisor to the President, and Director of the Future of Scholarly Knowledge Project, Columbia University

Rebecca W. Rimel, President and Chief Executive Officer, The Pew Charitable Trusts

Cristián Samper, President and Chief Executive Officer, Wildlife Conservation Society; former Director, Smithsonian National Museum of Natural History

Samuel O. Thier, Professor of Medicine and Health Care Policy, Emeritus, Harvard Medical School; President Emeritus, Brandeis University; former President, Massachusetts General Hospital; former President, Institute of Medicine, National Academy of Sciences

Project Staff

John Randell

Erica Palma Kimmerling

Alison Leaf

Keerthi Shetty

Shalin Jyotishi

TOP THREE TAKEAWAYS

from *Perceptions of Science in America*

(American Academy of Arts and Sciences, 2018)

1

Confidence in scientific leaders has remained relatively stable over the last thirty years. (SECTION 1: GENERAL PERCEPTIONS OF SCIENCE)

- Americans express strong support for public investment in research.
- A majority of Americans views scientific research as beneficial.
- Americans support an active role for science and scientists in public life.
- Americans have varying interpretations of the word "science" and the scientific process; additional research is necessary to understand how these differing interpretations influence perceptions of—and support for—science.

2

Confidence in science varies based on age, race, educational attainment, region, political ideology, and other characteristics.
(SECTION 2: DEMOGRAPHIC INFLUENCES ON GENERAL VIEWS OF SCIENCE)

- Although attitudes toward science are generally positive, the degree of confidence in science varies among demographic groups.
- For example, U.S. adults without a high school diploma are less likely than those with a college degree to view science as beneficial.

3

There is no single anti-science population, but more research is needed to understand what drives skepticism about specific science issues.
(SECTION 3: CASE STUDIES OF PERCEPTIONS ON SPECIFIC SCIENCE TOPICS)

- Attitudes toward science are not uniformly associated with one particular demographic group but instead vary based on the specific science issue.
- Recent research suggests that underlying factors, such as group identity, can strongly influence perceptions about science.
- A person's knowledge of science facts and research is not necessarily predictive of acceptance of the scientific consensus on a particular question. Indeed, for certain subgroups and for certain topics such as climate change, higher levels of science knowledge may even be associated with more-polarized views.
- More research is needed to determine how cultural experience and group identities shape trust in scientific research, and how to address skepticism of well-established scientific findings.
- Future studies should include an expanded definition of science literacy that incorporates the understanding of the scientific process and the capacity to evaluate conflicting scientific evidence.

The Public Face of Science

The American Academy's initiative on "The Public Face of Science" is a three-year project that began in Spring 2016 and involves a broad range of experts in communication, law, humanities, the arts, journalism, public affairs, and the physical, social, and life sciences. The initiative comprises a series of activities that address various aspects of the complex and evolving relationship between scientists and society and examine how trust in science is shaped by individual experiences, beliefs, and engagement with science.

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