



Visualizing the Landscape of Training Initiatives for Scientists in Public Engagement in the United States

2023 Inaugural Edition

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Foreword

This project grew out of a long-standing belief shared by the Lasker Foundation and Research!America that the science community must take steps to modernize its relationship with the public and that a critical way forward is to train scientists in the skills needed for effective public engagement. Embarking on the landscape project in late 2022, we were further motivated by surveys showing a decline in the public's trust in scientists. We were aware of various training initiatives, but how common were these opportunities? What content was being offered, where was it taking place, and who was participating? Getting our collective arms around the current state of training in public engagement is a necessary step in building greater support for civic science across academia. This includes gaining insights into the roles played by key partners in philanthropy, government, and scientific societies.

We hope the report and accompanying dashboard will be drawn on widely to inform and benefit a range of stakeholders: practitioners developing courses; students and faculty seeking training; funders interested in investing in new opportunities; and those in leadership positions within academia wanting to normalize public engagement training on their campus and across the country. Having illuminated the landscape of current practices, we are optimistic that the report and dashboard will serve as a springboard for new discussions, connections, and collaborations that will amplify the reach and impact of public engagement initiatives.

The landscape dashboard will continue to evolve with support from both our organizations over the next year and most importantly, through engagement with the broader civic science community.

Claire Pomeroy, President, Albert and Mary Lasker Foundation
Mary Woolley, President and CEO, Research!America

Executive Summary

This inaugural report aims to document the evolving landscape of public engagement training for scientists. The Training Initiatives for Scientists in Public Engagement Dashboard (TISPE), on which the report is based, is the first to provide a broad overview of training opportunities across the United States accompanied by dynamic visualizations to highlight their breadth and diversity. The report and dashboard are designed to inform a broad mix of stakeholders including training practitioners, aspiring and established scientists, university leaders, federal officials, foundations, policy advocates, and others. We hope this resource serves as a useful tool and catalyst for both existing and new conversations about public engagement training for scientists.

[ACCESS THE DASHBOARD](#)

Initial Insights

- **Training Opportunities:** Our ongoing search has so far identified more than 330 unique public engagement training opportunities including individual courses (26%), fellowships (22%), workshops/seminars (20%), and certificates (10%). Additional sources of training include degrees, conferences, internships, and others, which collectively account for the remaining roughly 21% of opportunities.
- **Host Organization Types:** Training is hosted by more than 200 unique institutions grouped into the following five categories: Colleges and universities (55%), scientific societies (27%), other nonprofit organizations (12%), government (4%), and for-profits (2%).
- **Target Participants:** Training initiatives are open to various career levels. Roughly 40% of programs are open to a combination of faculty, postdocs, and students across academic levels. Trainings targeting only graduate students make up 21%, while those targeting only undergraduates comprise 16%. There is a cluster of trainings exclusive to participants with a PhD or higher degree (14%). A very small cluster of trainings solely target underrepresented minorities. For all programs, there is a notable absence of publicly disclosed demographic data on participants.
- **Training Content and Objectives:** At the surface level, a majority of trainings — approximately three out of every five — are categorized under the umbrella term “science communication” based primarily on their titles. A deeper look at the content reveals a diverse range of focus areas with notable overlaps. Oral communication and writing are prominently emphasized and featured in about 40% of opportunities. Similarly, policy and advocacy are covered in some form in about 40% of initiatives. The use of multimedia tools (social media, audio, podcasting, etc.) is included in some 20% of training initiatives. Community engagement (including, listening, empathy, dialogue, etc.) is included in approximately 14% of initiatives. Other focus areas such as ethics, inclusion, and project design/management are currently underrepresented in publicly stated program objectives.

- **Communication of Impact:** Most training programs (73%) do not provide any form of impact metrics online. Among those that do, testimonials are the most common, shared by 12% of programs. Information on alumni careers or projects is available for 7% of programs. Other forms of showcasing impact, such as formal evaluations and general impact statements, are less frequent, appearing in only about 2% of websites. Peer-reviewed publications were found for less than 1% of the initiatives.
- **Credits:** Formal college credits are provided by courses, certificates, and degrees, which make up roughly 35% of the trainings found. Outside of formal university credit, a small number of training websites state that participants receive recognition via completion certificates, badges, and continuing education credits.
- **Accessibility:** Training length varies, with the most common spanning three months or fewer (38%), while another cluster (21%) spans 12–18 months, consisting mainly of fellowships. No duration is provided for about a third of the trainings in the dashboard. While many trainings are free to participants, some — particularly degrees, certificates, and specialized workshops — require fees. On-the-job training formats like fellowships often come with a salary or stipend and have competitive applications. Trainings are delivered in-person (50%) or in a hybrid or entirely virtual format (combined 40%), with the remainder being unknown.

Areas for Action

- **Training Developers:** Training developers are encouraged to articulate specific learning objectives on their websites to provide more clarity and precision in the descriptions for participants and stakeholders. This approach aids in aligning expectations and provides clear guidance on the skills and knowledge the training imparts. Additionally, it would be beneficial for developers to communicate the impact of their programs by posting summary impact statements. These statements should summarize the training outcomes, thereby providing participants and other stakeholders with a better understanding of the program's impact.
- **Universities:** Given the continued growth of initiatives around public engagement (training and practice), one essential step universities can take is establishing an institutional hub. This hub would act as a central point for coordinating and integrating public engagement training and practice across various university departments and offices. By creating such a hub, universities can facilitate more efficient resource sharing, foster interdisciplinary collaborations, discuss program impacts, and ensure a more unified approach to public engagement.
- **Funders:** Sponsors of public engagement are encouraged to provide additional funding opportunities for organizations and individuals interested in developing training initiatives. This funding could be used to support different dimensions of training (e.g., recruitment, evaluation, curriculum development, collaborations, and others) that are essential for building a sustainable ecosystem.

About the Dashboard

- Data Source: The information and insights presented in this report and dashboard are derived from publicly available data sources such as training initiative websites, publications, online directories, and conversations with stakeholders.
- Dashboard Updates: The dashboard is a work in progress and will be updated regularly with input from the public engagement community. As such, it serves as an evolving representation of the current landscape.
- Focus: The current version of the dashboard focuses exclusively on public engagement training initiatives within the United States and does not encompass training designed for the health professions such as medicine, nursing, and public health. This scope is subject to expansion in ongoing updates.
- Visualizations: Given the dynamic nature of the visualizations, the dashboard allows for multiple combinations of insights to be generated through various filters that make it easier for users to visualize the information according to their interests. An accompanying guide is available at the end of the report with additional information about the dashboard. A [how-to video](#) is also available on the dashboard.

Background

In the concluding remarks of a 2007 editorial in *Science*, Alan Leshner, then-CEO of the American Association for the Advancement of Science, penned the following statement: “If science is going to fully serve its societal mission in the future, we need to both encourage and equip the next generation of scientists to effectively engage with the broader society in which we work and live.”¹ The enduring call to action emphasizes the need for scientists to communicate and engage with diverse communities about the broader impacts of their research. Public dialogue on important topics such as climate change, vaccines, genetic engineering, and artificial intelligence, for instance, has highlighted the need for scientists not just to research, but also to communicate and engage.^{2,3}

Training is particularly important because effective public engagement with science requires specific skills that need to be learned and nurtured over time. Public engagement training can help scientists improve their ability to communicate their research findings, engage with diverse audiences, and effectively navigate public conversations about their science.^{4–8} Without effective training, scientists are left without the skills to navigate a complex terrain of challenges when communicating and engaging with diverse communities, which can constrain the broader societal impact of their research. The rapid digitization of information and the growth of social media platforms have also transformed modes of communication and engagement, making it crucial for scientists to learn about and adapt to new tools and platforms to engage diverse communities effectively.^{9,10} Providing effective training opportunities for scientists in public engagement is one of the key elements to strengthening the connections between science and society, promoting scientific literacy, building trust, and advancing science for the benefit of all.

Note: We are using the American Association for the Advancement of Science’s (AAAS) definition of public engagement with science as “intentional and meaningful interactions that provide opportunities for mutual learning between scientists and members of the public.” Visit the [AAAS Logic Model for Public Engagement with Science](#) to learn more.

A key goal of this report is to provide a dynamic overview of the growing public engagement training ecosystem in the U.S. supported by a range of stakeholders. By leveraging publicly available information shared by training initiatives, we created a dashboard for ongoing monitoring of trainings to serve as an additional resource for stakeholders to navigate and understand the growing landscape. Our aim in this first report and version of the dashboard is to supplement, not supplant, existing resources, contributing a nuanced and complementary layer of insight to the current body of knowledge.

This report and its accompanying dashboard aim to be accessible to a broad range of stakeholders, including fellowship program leaders, course instructors, scientists, graduate students, postdoctoral researchers, policymakers, funders, advocates, science PhD program administrators, and others who have a vested interest in the public engagement with science ecosystem. All these groups have a shared interest in strengthening the vital connections between science and society. By synthesizing and integrating some of the insights from past literature into our findings, we conclude by offering some actionable recommendations that we hope will set the stage for more targeted questions that invite further investigation.

Approach

The dynamic nature of public engagement training creates an ever-changing data landscape, with initiatives continually launching, pausing, rebranding, or closing. While some directories of public engagement trainings exist, to the best of our knowledge, none have leveraged data visualization as a primary approach to map the diverse parts of the landscape.^{11,12} Inspired by the dashboards developed during the COVID-19 pandemic by institutions such as Johns Hopkins University¹³ and the World Health Organization¹⁴, we sought to create a dashboard for science training initiatives related to public engagement. This tool aims to offer real-time snapshots of the current landscape, while also being flexible enough to adapt to inevitable changes. In this section, we briefly outline our open-source research approach to compile, categorize, and graphically represent the state of training initiatives in public engagement across the United States.

Data Sourcing and Compilation: Our research is anchored in publicly available data with the intention to provide a snapshot of current stakeholder observations and experiences in the public engagement training landscape. For the inaugural version of our dashboard, we focused on public engagement training initiatives available to those in basic science fields. We didn't map training specifically designed for those in the health professions or public health. (However, a number of the university-based training initiatives we found are open to these students.) We defined "training" as any organized initiative aimed at enhancing skills, exposure, knowledge base, and professional development in public engagement. Search terms were then used to find training initiatives including: "science communication," "public engagement," "science policy," "scicomm," "scipol," "sciengage," and specific combinations of "training," "courses," "seminars," "fellowships," "programs," "workshops," "certificates," "minors," "internships," "residencies," "apprenticeships," "bootcamps," "learning," "professional development," "co-op," "externships," and "continuing education". This enabled us to uncover initiatives (both active and inactive) that might otherwise have been overlooked. More broadly, we followed the philosophy of "highest possible resolution." We make an active effort to distinguish individual courses, programs within broader training centers, and standalone workshops to offer more granularity. However, if a certificate program encompassed numerous courses and workshops, we opted to list the certificate as a singular entity. The same logic applies to degree programs that offer a multitude of courses. Listing those courses individually was not practical. This decision was made to balance the resources available and the informational needs of diverse stakeholders.

For each initiative, we looked at various granular parameters such as mode of delivery, training content, and host organization type. Additional metrics include the duration of training, target participant demographics, geographical location, scientific field, availability of impact data, funders, training areas, and several other dimensions. These parameters aim to offer a multifaceted view of the field, facilitating user navigation and promoting data-driven decision-making among various stakeholders. Not all metrics could be located for each initiative. Additional insights into the search parameters and terminology are discussed in the dashboard guide.

Note: We are defining training as organized activities that include developing competency, enhancing exposure, building knowledge base, and fostering professional development, among others.

Search Tactics: To assemble the information, we employed multi-pronged search tactics. Advanced search operators were used in platforms such as Google, Bing, university catalogs and platforms such as the PCST, National Science Policy Network (NSPN), Coursicle, and other databases to find relevant initiatives. Where possible, automated web crawlers were deployed to extract specific data points based on predefined search terms that are discussed in more detail in the insights and dashboard guide sections. Scholarly publications served as another data source; key information was extracted from papers found on platforms like Google Scholar and PubMed. Finally, direct engagement with stakeholders at public engagement meetings and a survey sent to student leaders of NSPN university chapters provided additional information.

Data Visualization: We chose Google’s Looker Studio to host the first version of the public engagement training dashboard. Looker’s built-in functionality to visualize a diverse range of parameters fit well with our goal of offering a multi-dimensional view of metrics derived from training initiatives. Its interactive visualizations provide an immersive user experience, enabling stakeholders to explore data across dimensions.

The dashboard guide provides a breakdown of the main figures on the dashboard and an overview of the categorization.

Insights

The interactive dashboard is accessible online and features a range of interconnected graphs that the user can interact with. The dashboard includes an open-ended search function permitting keyword-based queries across the descriptions of public engagement training initiatives and a portal to submit new or missing trainings. Detailed taxonomy and guidance on navigating the dashboard is available in the dashboard guide at the end of this report. The following visualizations are designed to serve as both a snapshot of the current landscape and a springboard for further inquiry. The snapshots spotlight gaps in our understanding and present opportunities for further development.

Access Points

Guiding question: *What types of access points offer public engagement training?*

Our mapping has so far identified over 330 science public engagement training initiatives across the United States, offering a robust snapshot of the current landscape. Figure 1 shows the distribution of these initiatives by access point revealing that individual courses constitute approximately one quarter of the opportunities, and the majority are taught at universities across different departments, colleges, and centers. Examples include: “Engl-312: Communicating Science and Public Engagement” in the English Department at Iowa State University, which emphasizes rhetorical concepts and strategies for communicating scientific topics; “Msch-J554: Science Writing” in the School of Informatics, Computing, and Engineering at Indiana University, which

explores the challenges and opportunities associated with writing about science for non-scientists; “Envr 4000: Science Communication and Professional Development” in the Communication Studies Department at Northeastern University, which covers professional skills and principles of messaging, and “ORGEVBI 697K: Special Topics in Science Communication” in the Department of Organismic and Evolutionary Biology at the University of Massachusetts, Amherst, which is designed for graduate students in the life sciences to experience communicating science to audiences outside their academic field.

Beyond individual courses, other access points include fellowships, workshops, certificates, degrees, conferences, internships, and a growing number of staffed centers focused on various aspects of public engagement with science. Such diversity of access points may help to enhance accessibility and cater to the learning needs and professional goals of different stakeholders, including undergraduate and graduate students, postdoctoral fellows, faculty, and other professionals who are seeking training opportunities. However, this raises important questions. Specifically, how discoverable are these training opportunities, and perhaps more critically, to what extent are they being utilized by their intended target participants?

Initiatives like the Alan Alda Center for Communicating Science at Stony Brook University can serve as one-stop shops, offering a diverse array of public engagement training initiatives. They act as centralized access points for various stakeholders, ranging from students and faculty to professionals. The availability of diverse training types, from individual courses to workshops and fellowships, allows for an integrated, holistic educational experience. This complexity is likely managed by dedicated full-time staff who ensure the smooth operation of these diverse initiatives (e.g., grant writing, curriculum development, mentoring, event management, etc.), which also enhances the likelihood of garnering sustained institutional support. This confluence of easy access, varied training options, and institutional backing makes such centers potentially pivotal elements in the public engagement training landscape.

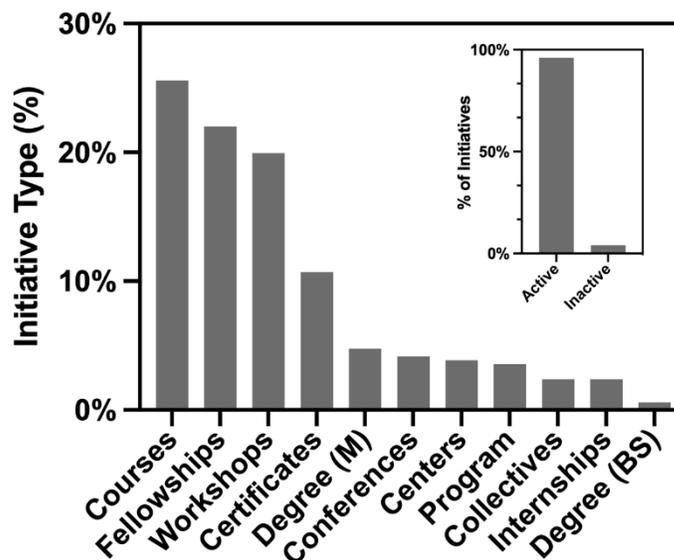


Figure 1: The bar chart displays the frequency of various types of public engagement training access points. The inset bar chart displays the distribution of the active vs. inactive status of training initiatives.

Explore: Located in the College of Agricultural and Life Sciences at the University of Wisconsin-Madison, the Department of Life Sciences Communication (LSC) provides a comprehensive suite of training initiatives that include undergraduate and master’s degree programs, certificates, minors, and a variety of standalone professional and summer courses across diverse skill areas in science communication.

The Center for the Communication of Science at Montana State University aims to foster interdisciplinary research and education between STEM and arts disciplines. It focuses on bridging the public understanding gap in science through a blend of academic programs, speaker series, and workshops. Similarly, the Scientific Citizenship Initiative at Harvard University offers training courses (such as “ditching the deficit model”), seminars, and a civic science clinic all designed to cultivate skills necessary for effective leadership, communication, policy, and ethics within the scientific community. The Center for Communicating Science at Virginia Tech provides experiential learning opportunities, leveraging tools from the arts such as improvisation and storytelling. It offer workshops, seminars, and professional development events aimed at enhancing communication skills, particularly for researchers aiming to reach audiences outside their specialties. Of course, the data presented in Figure 1 captures a specific moment in time, and it is reasonable to assume that the frequency and access points of training initiatives are not static but dynamically evolving. Tracking this distribution over time is essential for understanding trends and shifts in the field. Periodic snapshots would offer valuable insights into how the landscape of public engagement training is adapting to new challenges and opportunities.

It's important to acknowledge that initiatives have a life cycle, and some may eventually cease operations or transform into something different over time. Figure 1 (inset) shows that there is a cluster of inactive initiatives that should not be ignored. Intriguingly, these inactive initiatives are still accessible online but no longer accept applicants. As such, the actual number of inactive initiatives is likely much higher since many simply remove their online presence altogether. The reasons for the termination of these initiatives should be an area of active interest in the future and are likely to include factors such as funding constraints, leadership changes, competition, or changing field priorities. For example, the Santa Fe Science Writing Workshop started in 1996 and concluded operations in 2022. Their website provides the following statement:

“After 25 successful workshops, drawing approximately 1,000 people from around the world, we have decided to call it a wrap. When we began in 1996, we hardly imagined that the Santa Fe Science Writing Workshop would go on to attract such an interesting and talented crowd, and we thank you all for being part of this...”

Mapping the lifespans of each initiative would be useful in elucidating their evolutionary trajectories over time. Similarly pressing is the issue of data management for programs that have become inactive. Such data includes program impact metrics, which could encompass measures like participant learnings, testimonials, program operations, and also the research findings that may have been published or utilized in the development of the program. Formal evaluation reports that summarize the program's achievements against its objectives are also of interest in addition to any curricular materials. Given that this information could be invaluable for the improvement of current initiatives and development of future ones, it is crucial to ensure such information remains accessible beyond the life of any given initiative.

Hosting Organizations

Guiding question: What types of organizations are hosting these training initiatives?

The next natural question to ask is about the type of organizations hosting public engagement training initiatives based on the data we collected. Figure 2A reveals a landscape significantly shaped by academic institutions, with a large majority of the initiatives found at universities. Other nonprofit entities account for approximately 27% of the initiatives.

Figure 2B provides more granularity. When we focus on the breakdown of training types within universities, individual courses emerge as the most prevalent, constituting approximately 33% of the initiatives.

Note: Non-profit organizations such as the Story Collider serve as important complements to academic institutions. The Story Collider, for instance, offers training that leverages a diverse team of instructors — from PhD scientists to writers and performers — to provide storytelling workshops, coaching, and lectures.

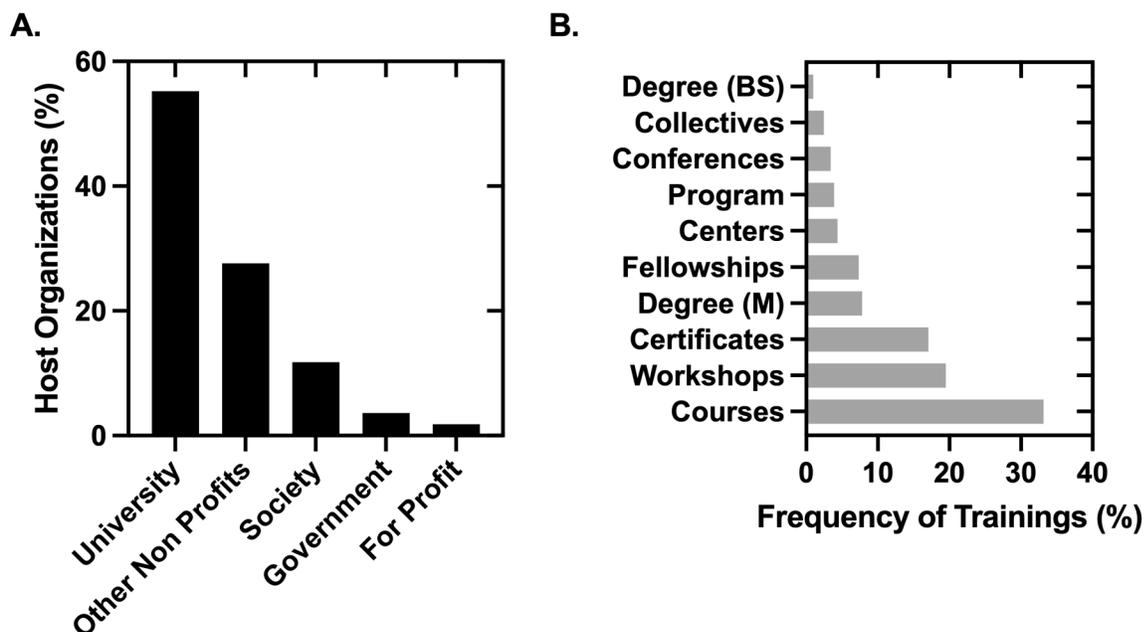


Figure 2. (A) The bar chart displays the percentage of unique organizations hosting public engagement training related initiatives (n=220). (B) The bar chart displays the percent frequency distribution of training located within universities.

Master's degrees, fellowships, workshops, and certificates are also a significant part of offerings. Therein lies the problem: the siloing effect within universities. Civic science — including public engagement, science policy, and science communication — are scattered across multiple departments. For instance, a course or workshop in science communication might be found in the journalism department, while another similar course could be part of the biology department. The level of connectivity and collaboration between initiatives is worthwhile to investigate in greater detail in future reports. One could hypothesize that the level of connectivity among public

engagement training initiatives within a given university has a significant impact on their effectiveness, reach, and long-term sustainability.

Upon closer examination of public engagement training activities at universities, we recognize several notable hubs in addition to Stony Brook University. Among them are Cornell University, Duke University, University of Rhode Island (Metcalf Institute) University of Chicago, and Tufts University (Tufts Initiative in Civic Science) and several

Explore: 2023 marked the 25th anniversary of the Metcalf Institute at the University of Rhode Island. Click to access the [2022 Annual Report](#) which summarizes its accomplishments.

others. These universities could be considered hubs due to the growing diversity of training offered, which includes courses, workshops, programs, symposia, and centers dedicated to public engagement with science. The University of Rhode Island, for example, provides a range of courses, programs, and symposia. For instance, its Inclusive SciComm Symposium serves as a gathering point focusing on inclusion, equity, and intersectionality in science communication. The Graduate Certificate in Science Writing and Rhetoric aims to equip students with the skills to translate complex scientific findings for various audiences, preparing them for roles such as science writer and communication specialist. Metcalf's SciComm Exchange and SciComm Identities Project (SCIP) further extend the institute's reach by fostering community conversations and targeting the training needs of minority scientists. Furthermore, its Career Development Program Certificate offers a comprehensive set of modules that cover topics from diversity and inclusion to effective mentorship and time management. Additionally, courses like NRS 543: Public Engagement with Science provide both theoretical grounding and practical experience in science communication.¹⁵

We have found more than 100 unique 4-year colleges and universities offering training options, such as courses, workshops, and fellowships. We anticipate finding even more as the landscaping continues. However, it's important to note that the training initiatives are not weighted; a course and a workshop, for instance, are both counted as a single entry at the present time. As a result, gauging the true level of "activity" levels at each university is tricky and is a task that can be completed more accurately at the local level.

Some campuses have made efforts to map training opportunities. For example, the Science Policy Group at the University of Illinois at Urbana-Champaign has mapped relevant courses for its science policy certificate for university members to explore by college and department (Figure 3). Although the courses in the visual go beyond science engagement and communication, the value of providing such maps (beyond courses) at the local university level is well made: Individual universities should develop local directories specifically for public engagement-related experiences for their students.

Our mapping uncovered that colleges and universities appear to house the greatest share of public engagement training, comprising almost half of the unique organizations found in this report. A number of questions come to the fore: With nearly 3,000 4-year colleges and universities in the United States, how do we dramatically increase from the first 100+ we uncovered the number providing public engagement training for scientists across academic levels? What mechanisms could be put in place to foster greater collaboration both within academic departments and across different higher education institutions? Furthermore, given that most of the curricula and material from these courses are not publicly accessible, how can we make it available to benefit the larger community of training developers and leaders? How do course instructors decide what to teach? And similar to Figure 1, how can we track and store the lessons learned from past trainings? Explore the Discussion & Recommendations section to learn more about some of the ideas we are proposing.

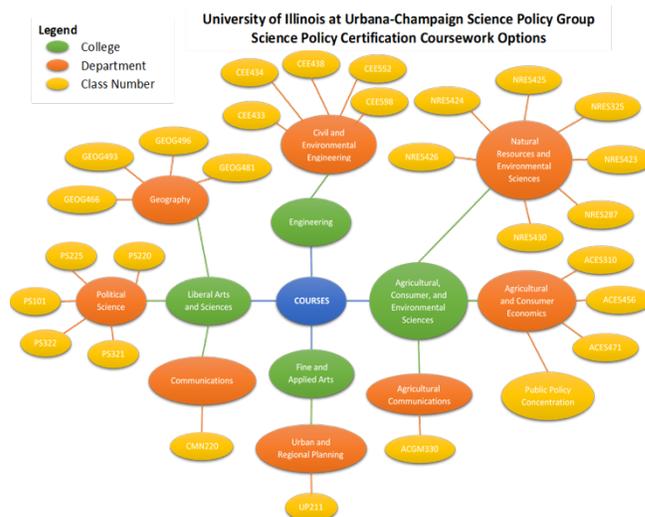


Figure 3. The actual graphic conceptualized by Caitlin Race of the Science Policy Group at the University of Illinois at Urbana-Champaign shown here is also available on the website.

Target Participants

Guiding question: Who are the target participants for training initiatives?

Understanding the characteristics of target participants (e.g., career stage, gender, and other relevant dimensions) in public engagement training initiatives is paramount for several reasons. It provides a lens through which we can gauge the existing state of the public engagement workforce, and also offers valuable insights into the effectiveness of recruitment mechanisms. As shown in Figure 4A, the training landscape is highly diversified in terms of target participants. While some training opportunities exclusively cater to specific groups of participants, a significant majority of initiatives aim to train a range of participants ranging from faculty members to post-graduate researchers and students at various academic levels.

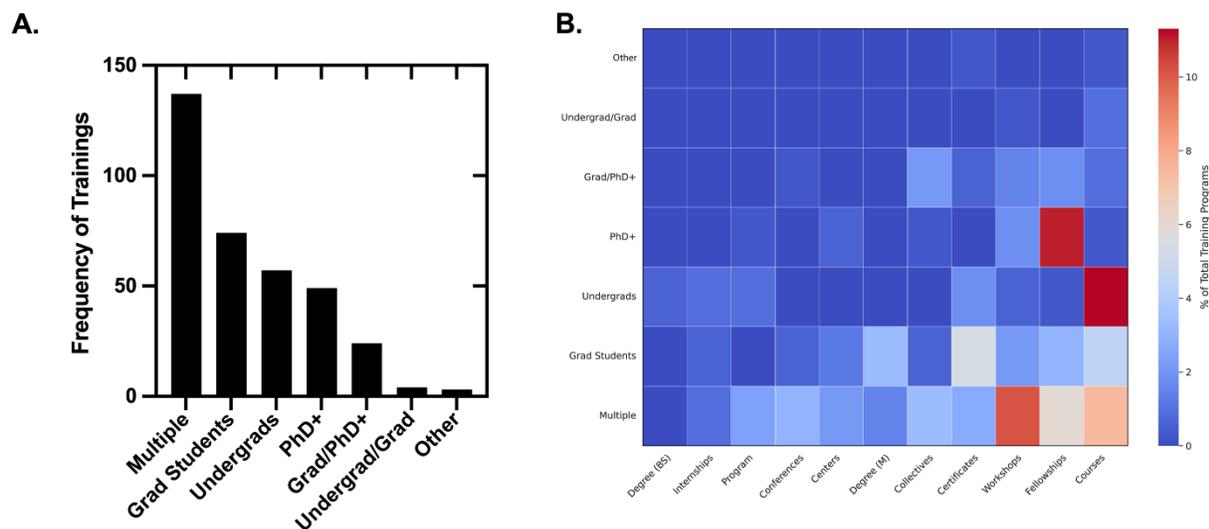


Figure 4. Analysis of Target Participants of Public Engagement Training Programs. Panel A displays a bar graph of target participants distribution across training initiatives. Each bar represents a category of target participants. Trainings were labeled with the multiple category if it was determined that they targeted three or more groups of participants. Panel B is a heatmap that shows the relationship between these target participants and various types of training opportunities such as workshops, courses, certificates, etc. The color gradient represents percentages calculated through global normalization, indicating the proportion each cell contributes to the total number of training programs in the dataset. Warmer colors denote higher proportions.

There is a correlation between the types of training opportunities and the target audiences. Courses, which are predominantly university based, tend to be the target for undergraduate and graduate students. In contrast, fellowships and workshops, as depicted in Figure 4, Panel B, better serve the needs of what we term “PhD+” — a category that includes postdocs, faculty members, and professionals with higher degrees. Our analysis also revealed a lack of standardization in the language used to describe target participants across trainings. The term “early career researchers,” for example, was found to be very prevalent, and at times was not clear which specific groups it referenced since it means different things to different people.

While diversity and inclusion are commonly cited objectives among program organizers, almost no training initiatives websites provide racial and ethnic demographic data on past participants.

When that data are available online, it is usually the total number of participants shared as an output metric. In their conversations with science communication fellowship program directors, Dudo et al. noted in their 2020 report that “many respondents lamented their program’s lack of diversity in the makeup of their fellows” and pointed to “the lack of diversity in STEM fields as a whole to the lack of diversity — especially ethnic diversity — seen in their applicant pools” in the science communication fellowship programs.¹⁶

Some programs, such as the SPARK Inclusive Science Communication program at the University of Minnesota, have addressed the lack of diversity in public engagement by focusing on underrepresented minorities. The SPARK program states it “will initially target graduate researchers in STEM-based fields who identify as Black, Indigenous, and persons of color (BIPOC) to help deepen the understanding of the science communication principles through the lenses of inclusion, equity, and intersectionality.” Two additional programs, the Metcalf Institute’s SciComm Identities Project Fellowship and the HBCU and MSI Science Policy College Tour (hosted by the National Science Policy Network), also have goals of focusing on recruiting only minority participants in their programs. For example, on its website, the SciComm Identities Project Fellowship mentions that the opportunity is a “one-year professional development opportunity for pre-tenure faculty at U.S. institutions who identify as underrepresented racial or ethnic minorities. Another example is the Research!America Civic Engagement Microgrant Program, which convened stakeholders through a set of roundtables to discuss recruitment strategies aimed at diversifying their applicant pools.

Beyond the anecdotal, we do not have a good grasp on participation numbers and, more important, the experiences of racial minorities in the broader public engagement workforce. This is a rich area both for more detailed investigation in future reports and action from current stakeholders.

Explore: The Civic Engagement Microgrant Program provides funding of up to \$4,000 to STEM graduate student and postdoc-led groups to “design and execute projects that create dialogue with public officials, local community leaders, and the public around issues of common concern.” The program states that “these funds provide opportunities for grantees to develop skills in areas such as communication and program planning, along with an understanding of public policy and government to have an impact in their local communities.”

Training Content

Guiding question: What skill areas are the participants being trained in?

The foundation of the taxonomy for the skill areas is adapted from the 2019 and 2022 articles by Aurbach et al., and Lewenstein and Baram-Tsabari^{17,18} (the breakdown of the taxonomy is available in the dashboard guide). These categories are mapped onto the stated objectives and learning goals across various training initiatives. Oral communication — encompassing speaking, expression, and public speaking — stands at the core (Figure 5) confirming what others have reported previously.^{19,20} These are often supplemented by training in writing skills, audience analysis, multimedia tools, and general professional development. However, coverage of topics varies due to constraints like

time, funding, expertise, and stakeholder interest. Most programs focus on two to three category areas with science policy training initiatives often offering both general communication skills and specialized policy and advocacy training. A recent report featuring semi-structured interviews with individuals working in various science policy careers found that writing, oral communication, and managing projects were among the most cited skills for success in science policy.²¹ However, more research is needed to provide better resolution on the core skills involved in science policy. Critical areas such as inclusion and ethics are less frequently represented. Although there is a general agreement that inclusive practices are being increasingly covered in training and at conferences, the opportunities for scientists to learn how to practice inclusive public engagement with science are still extremely limited.²² Project management, which includes aspects such as event design, planning, and management, is also not well represented. Exceptions to this include the Research America Microgrants Program, which provides both funding and targeted training in project management, policy and advocacy, and a few other areas.

The data we have collected and some anecdotal conversations with stakeholders confirm the general sentiment that current training leans heavily toward tactical skills with less emphasis on the larger conceptual knowledge (theoretical and conceptual frameworks) of public engagement or the broader social/political environment in which science operates, termed the “public context of science.”²³ Examples of this include a critical review of the theoretical models, terminology, and

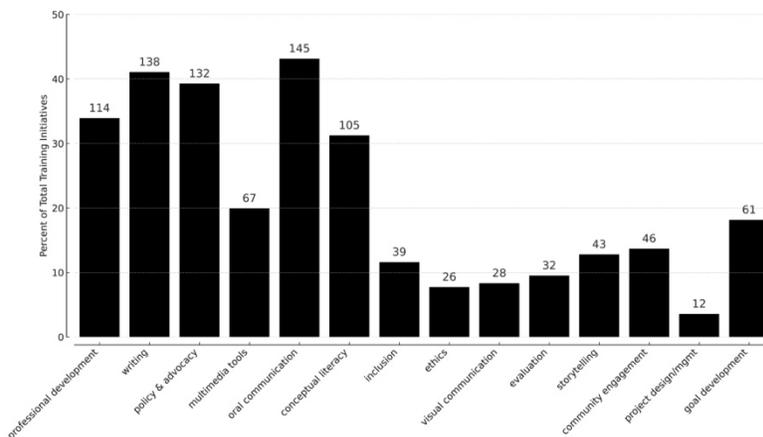


Figure 5. Comparative mapping of training areas in public engagement. The bar graph visualizes the percentage frequency of 14 categories. Raw counts at the time of publication for each category are indicated above the respective bars. Note that the designation was binary in nature, meaning the classifications are not weighted by the actual level a given initiative covers a specific skill area. It is a simple yes or no whether that skill set is covered. Future projects may consider examining this question within specific types of trainings.

emerging scholarship in public engagement. The inclusion of such frameworks is crucial because they provide participants with the necessary foundation to guide the long-term practice of public engagement with science. Below is an example of a course that strongly emphasizes the conceptual frameworks:

Table 1	
Attribute	Details
Name	Comm/STS 6660, Public Engagement in Science
Institution	Cornell University
Instructor	Bruce Lewenstein, Professor of Science Communication
Description	In recent years, the scientific community has increasingly referred to public engagement in science. This seminar explores the scholarly literature addressing that move; the links between “public engagement” and earlier concerns about sciences literacy, public understanding of science and outreach; and the intersections between literature in communication and in science studies on issues involving the relationships among science(s) and public(s).
Learning Objectives	<p>After completing this course, students will be able to:</p> <ul style="list-style-type: none"> • Understand the consensus about public engagement in science • Understand key issues emerging in current scholarly debates about public engagement in science, especially around issues of equity and justice • Identify holes in current scholarship on public engagement in science • Plan, write, and present literature reviews on issues in public engagement in science

Ultimately, it is important to integrate both conceptual frameworks and practical skills in a balanced learning pathway. This sentiment is captured well by a stakeholder who observed, “I think we run into a lot of issues in science communication when we really try to just home in on transmitting messages and not actually think about the whole world in which this transmission is happening and what else is going on.” By fostering a deeper understanding of these frameworks, training initiatives have the potential to build engagement expertise and significantly contribute to integrating civic science more broadly as one of the core elements of the scientific enterprise. While explicit articulation of these objectives is often absent and is further complicated by a lack of common vocabulary to describe them, their clarity and specificity are pivotal for impact assessment.

Guiding question: How do public engagement training initiatives communicate the impact of the training provided?

Evaluating the impact of public engagement training initiatives presents another complexity. In our analysis, we found that the majority of training initiatives do not publicly disclose impact data. When they do, testimonials are the predominant method to communicate impact, followed by

various other ways ranging from alumni career outcomes and projects to formal evaluations and peer-reviewed publications. Several initiatives employ summary impact statements to succinctly convey the benefits of their training programs, serving as a quick reference for potential participants and a resource for prospective funders. For instance, the OMSI Science Communication Fellowship at Oregon State University has been highly rated by participating scientists for its efficacy in enhancing communication skills and public engagement. Similarly, the Science Communication Bootcamp hosted at the Indiana University School of Medicine offers a 3-day intensive training aiming to hone audience-centered communication skills among faculty, postdoctoral researchers, and graduate students, with positive feedback on increased communication skills and willingness to engage with non-specialist audiences. Below are some of the actual impact statements we encountered:

Table 2	
Program	Impact Statements
OMSI Science Communication Fellowship (Oregon State University)	<p>An in-depth evaluation of the OMSI Fellowship program revealed that scientists who participate in the program:</p> <ul style="list-style-type: none"> • Believe it was well worth the time and effort that they put in and would recommend it to a colleague, rating the program 9.3 on a scale of 1–10 on average. • Report improved pedagogical and communication abilities and skills • Participate in an average of seven public events per year 95% of those surveyed reported an improvement in the quality of their public engagement
Science Communication Bootcamp Indiana University	<p>The 3-day program engaged and immersed participants in training designed to develop audience-centered communication, distill scientific concepts into meaningful narratives, and connect effectively with the public, collaborators, and policymakers. Based on participant surveys at three-time points (preworkshop, postworkshop, and 2-year follow-up), the SCBC was effective in helping participants to increase their communication skills and willingness to engage with the public and other non-specialist audiences.</p>
Sharing Science Program, American Geophysical Union (AGU)	<p>Year after year, over 90% of attendees rate our workshops as excellent.</p> <p>Attendees' confidence in their ability to communicate science to wider audiences increases by an average of 30%, with some attendees reporting that our workshops have boosted their confidence in their abilities by 70%. From Serna B. Lee: "Very engaging. I felt that I was able to get a lot of assistance on a personal level, which is sometimes difficult to obtain when at a workshop w/people from different research areas. The workshop provided me with new perspectives on how to better present my research to a wide range of audiences. I came away w/ new tools that I am going to use straight away."</p>

Although not frequent, some programs do showcase a detailed breakdown of their external evaluations on their program websites. For example, the Science Communication Online Program

(SCOPE) at Northwestern University utilized an external firm to conduct a comprehensive external evaluation which included pre- and post-program surveys, interviews, and content analysis of the participants' work to gauge the impact of SCOPE on its participants from the first cohort in summer 2020.²⁴ The external evaluation focused on four main goals: improving cross-disciplinary communication, effective utilization of visuals, mastering techniques in persuasive communication, and adapting writing styles for different audiences. The evaluation report noted that most respondents had increased ratings in all the aforementioned areas compared to their ratings before the course (Figure 6).

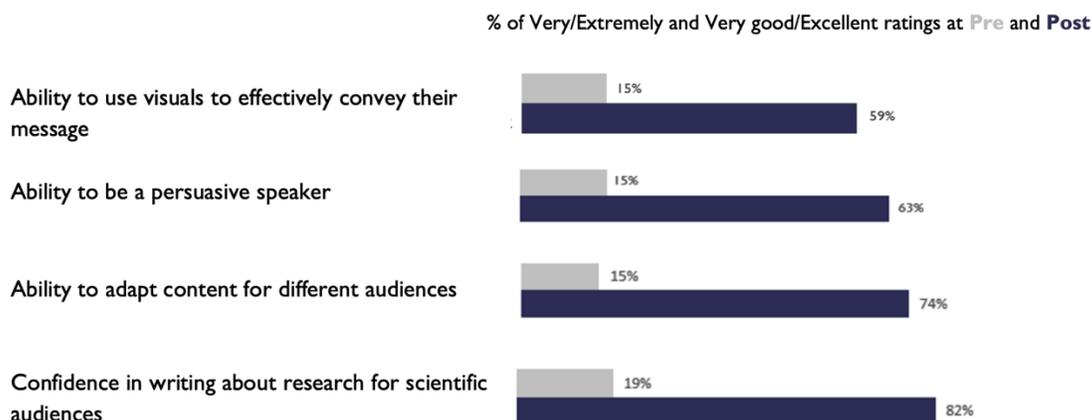


Figure 6. Changes in skill areas after participating in the course compared to ratings before the course. The figure is taken from the external evaluation report generated by The Mark USA and shows responses from 27 of the 46 students who enrolled in the course, (57% response rate).

Participant testimonials corroborated the quantitative findings in the evaluation report. One participant emphasized the newfound appreciation for visual communication, stating, “the rhetorical strategies, storytelling framework, and visualization strategies were the most impactful for me.” Another mentioned the course’s broader impact, noting, “I found this entire course incredibly useful... my most important takeaways are probably crafting the narrative of my research and using effective visualizations.” The value of working with one’s own content was highlighted by another participant who said:

“The modules where we workshopped our own content were the most helpful for improving my own communication skills. Modules that did this especially well were the ones in which we submitted a title or one-minute talk, got feedback from peers, then resubmitted with improvements. That forced me to think about how to actually improve what I had made or thought of, rather than just learning about the theory of how to do something better. For this reason, as well as the other assignments, I found this to be one of the most effective online courses I’ve taken.”²⁴

Some training initiatives have extended their evaluation scope to include peer-reviewed publications. For example, an undergraduate neuroimmunology course at Stanford University designed by Sarah Brownell and her colleagues was offered for three consecutive years and employed a rigorous mixed-methods evaluation approach. Students in this writing-intensive course

reported significant gains in writing self-efficacy, biology content knowledge, and, notably, increased confidence in communicating science to both scientific and layperson audiences.²⁵ Another example is a publication in the *Journal of Microbiology and Biology Education* from ComSciCon-Triangle, a North Carolina-based workshop series designed for STEM graduate students. Initiated in 2015, this annual workshop “aims to empower graduate students to be more engaged in communicating their research with the public as well as with fellow scientists.” The curriculum includes interactive panel discussions, networking opportunities, and hands-on sessions to refine both oral and written communication skills. In the 2018 paper, they showcase their analysis of pre- and post-workshop survey data from 2015 to 2017 which revealed that attendees gained significant confidence in communicating scientific ideas to both non-scientists and scientific audiences, and that they also felt more confident in submitting written pieces to popular science publications or journals.²⁶

A recent study conducted a comprehensive review of 16 published articles to assess the impact of communication training programs on oral skills among STEM professionals.²⁰ The authors of the study underscore the positive effects of communication training for STEM professionals and elaborate an important point about future researchers needing to “identify a systematic means for collecting and analyzing unpublished evaluations from relevant training programs.” The proliferation of research will be instrumental in elucidating the tangible benefits and value of these training initiatives. More important, communicating the research to diverse stakeholders will be equally valuable.

Certainly, as highlighted by prior research, staffing and funding constraints often pose significant barriers to comprehensive evaluation activities.¹⁶ Yet, effectively communicating the impact of training initiatives remains a requirement for their long-term success and sustainability in the field of public engagement. Collaboration between researchers and training developers will be necessary. This urgency raises an important question: Could there be a core set of training impact metrics for all initiatives (including university courses) to track and publicly disclose? Answering this and other related questions could pave the way for a more unified approach to the communication of impact around public engagement training.

Accessibility

Guiding question: How accessible are the public engagement training initiatives?

Duration: Mapping the duration of training initiatives (Figure 7) offers valuable insights into the level of commitment required from participants. This is especially pertinent for those interested in acquiring a diverse set of skills that may need to combine a mixture of trainings, as well as those who want to evaluate the efficacy of different types of training. As indicated previously, the first major cluster of initiatives fall within the short time scale ranging from mere hours to about 2–3 weeks. Such initiatives, often in the form of workshops or short courses, enable a broad spectrum of participants to engage in training without making a long-term commitment. For example, the National Institutes of Health (NIH) offers an “Art of Science Communication” online course lasting 90 minutes that provides 1.5 continuing education credits for those who complete it. The course lists a range of course objectives that include understanding the “difference between the way scientists communicate with each other versus the way scientists should communicate outside of science, learning key components of effective science communication, and the practice of science communication.” Another example is the American Association for Anatomy, which hosts a 2-day SciComm Bootcamp (SBC) which states that it trains participants on “applied improvisational theater techniques to connect effectively with audiences, distill complex scientific concepts into understandable language, and use storytelling as a mechanism for effective communication.”

On the Dashboard: There is a dedicated figure that allows the user to explore the different durations of initiatives and explore them against other aspects such as target participants, location, outcome types, hosting organization, and so forth.

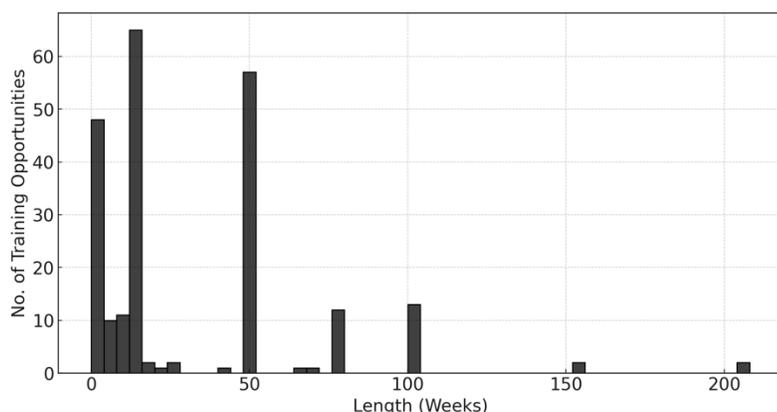


Figure 7: Distribution of lengths of public engagement training initiatives. The histogram shows the distribution of durations of training initiatives, binned in 4-week intervals. The x-axis represents the length of the initiatives where the duration was possible to determine ($n=228$; 67% of the mapped initiatives) in weeks, while the y-axis indicates the frequency of initiatives within each bin.

University courses, which typically span approximately three months, constitute another significant category. These courses provide the necessary room to go more in-depth into specific areas and require a larger time commitment from participants. Fellowships (most in science policy) and master’s degrees account for the second major cluster in the distribution, with many spanning between 12–18 months. These programs are better positioned to offer more immersive experiences and are generally tailored for deeper engagements. As the duration increases, we observe a significant drop-off in the number of initiatives available. One notable opportunity is the Bachelor of Arts in Science Communication offered by the Stevens Institute of Technology in New Jersey, which spans the traditional 3–4 years it could take to complete an undergraduate degree and covers a comprehensive curriculum teaching students “processes for data gathering, interviewing, reporting, storytelling, and clear presentation of complex information.”

Of course, the duration of any given training does not provide information about the quality of the educational experience. Rather, it only serves as an indicator of the time commitment required and, by extension, the accessibility of the initiative. When examining the optimal length of a program, multiple factors come into play, including the learning goals, content, funding, and the logistical limitations of the hosting institution. The intended audience also plays a significant role. Faculty members, for instance, are often more inclined to participate in short-term initiatives due to other professional and academic obligations. Consequently, a challenge emerges when attempting to gauge the effectiveness of training initiatives with different durations, particularly when comparing disparate types of training such as workshops and certificate programs. It is tempting to ponder whether there is such a thing as the most optimal duration of a training initiative. A better approach would involve assessing how the duration of specific training formats influences learning outcomes for a given skill set.

Delivery

Delivery and Cost: Delivery of public engagement training is another important factor. In our mapping, about half of the initiatives are conducted in person, 22% are hybrid, and about 17% are purely virtual (Figure 8). Online availability inherently widens the pool of potential participants by breaking down geographical barriers that might otherwise limit participation.

For instance, fellowships and conferences are largely in-person, while workshops deliver in all formats. How the distribution changes over time will be interesting to track. While a significant number of initiatives are free to participants, cost can be a prohibitive factor for others. Participants encounter a wide range of fees. For instance, the Inclusive SciComm Conference registration fee is \$50, while the Science Policy and Diplomacy course at the University of Arizona fee is \$1,250, although discounts are available. Upon successful course completion, participants are awarded a digital badge and a digital certificate of accomplishment by the University of Arizona Continuing and Professional Education. Similarly, the American Association for Anatomy's (AAA) Science Communication Bootcamp charges \$200 for faculty who are members and \$50 for student or postdoc members. For non-members, the fees rise to \$300 for faculty and \$75 for students and postdocs. The mapping reveals that participants are weighing multiple variables — ranging from duration and cost to delivery method and content — in their decision-making process. What combination of factors holds the most significance for different participants might be an interesting avenue for researchers to explore.

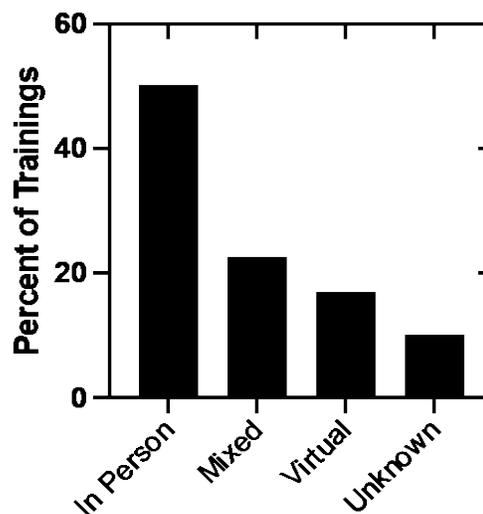


Figure 8. Delivery of training initiatives across formats. The bar graph shows the distribution (%) across in person, mixed, virtual, and unknown.

Funding

Guiding question: Which organizations are funding public engagement training initiatives?

While universities serve as the primary financial backers for many academic courses in public engagement, it is common practice for training initiatives to draw from a diverse pool of funders. In assessing training initiative websites, we found an array of past and current funders listed online. They include private foundations, the federal government, corporate sponsors, societies, and other nonprofit organizations. At the federal level, notable funders include the National Science Foundation (NSF) and the National Institutes of Health (NIH). The NSF has a variety of funding mechanisms catering to this domain. Programs like the Integrative Graduate Education and Research Traineeship and the Advancing Informal STEM Learning (AISL) offer some targeted pathways that training developers can propose for specific initiatives. For example, NSF's AISL funding program is designed in such a way that public engagement training could be approached from various angles through five types of projects. They include synthesis projects, conference projects, partnership development and planning projects, integrating research and practice projects, and research in support of wide-reaching public engagement with STEM projects.^{27,28} Moreover, the broader impacts criterion for all NSF research grants provide an avenue for training-related work that can be added into individual faculty grants.²⁹ Similarly, the NIH offers avenues for funding through training grants, allowing for supplemental support for public engagement training in existing graduate programs.

Explore: Organized by the Rita Allen Foundation, the [Civic Science Fellows Program](#) is supported by a number of partner funders who provide financial support for the fellows and their host institutions in addition to extensive professional development opportunities.

Notable support also comes from a number of private foundations, societies, and corporate sponsors. While many funders offer funding for public engagement with science that is broadly defined, we found that training is typically not mentioned as an area of focus. As such, it is plausible that the lack of emphasis on training could deter some potential applicants from applying and/or be overlooked during the review process leading to missed opportunities in supporting innovative training initiatives. Dedicated support specifically for training will be vital, especially as the needs and opportunities in public engagement evolve. More research is needed to provide training developers and other stakeholders with an updated understanding of the funding priorities within public engagement and provide additional guidance for funders on additional ways to support training. This could include detailed studies on the allocation of funds between practice and training and the impact of short-term versus long-term grants on training program sustainability.

Discussion & Action Areas

Drawing on biology for an analogy, the landscape of training initiatives in public engagement with science can be compared to a complex biological cell, comprising a diverse array of stakeholders that function like organelles within a cell (Figure 9). Much like the cell, each organelle has a specific function that contributes to the overall vitality of the organism. The guiding philosophy, principles, and beliefs around public engagement with science form part of the nucleus, containing the DNA that provides the foundational instructions and identity for most of the activities within the ecosystem. Training developers, ranging from faculty to individual entrepreneurs, function like ribosomes, translating the training content. Funders serve as the mitochondria, offering the financial energy that powers the cell. Researchers and evaluators resemble the endoplasmic reticulum, channeling assessments and theoretical frameworks to refine its functions.

Advocates and policymakers act like the cell membrane, shaping the external environment for long-term growth. Participants, or trainees, serve as the cytoplasm, the medium in which all these elements interact and where vital transformations occur. What ends up truly defining this cellular ecosystem is the strength of the connections between the organelles, akin to intracellular signaling pathways. These connections determine how well the cell, or ecosystem, adapts and ultimately thrives. Therefore, tracking, understanding, and nurturing these connections is essential for the holistic development and sustainability of public engagement training.

Over the past decade, useful recommendations have emerged from reports and articles examining different aspects of the public engagement training landscape. These recommendations are diverse in scope and focus, but we note some clustering around the individual, programmatic, organizational, and policy levels (Figure 10). Briefly, at the individual

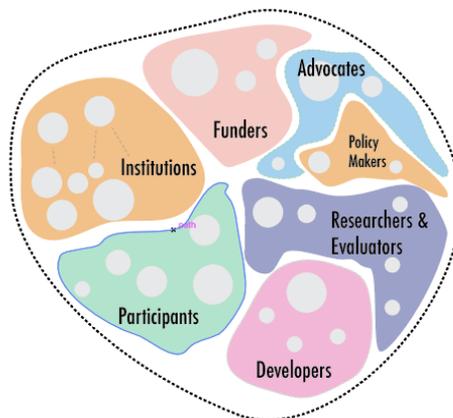


Figure 9. The developing landscape of stakeholders within the public engagement training landscape. The different types of stakeholders are represented within the colored clusters. The grey bubbles inside represent the diversity of the stakeholders within the clusters. For example, participants include undergraduates, PhD students, postdocs, faculty, and others.

level (graduate students, scientists, postdocs, program directors, etc.), we continue to gain understanding about the specific motivations, needs, barriers, and perspectives with respect to science communication and engagement.^{30–32} For example, we know that STEM graduate students express concerns about their skills and efficacy in science communication and that their advisors are often not equipped to mentor them in the area.³⁰ Such insights are useful when it comes to designing new trainings and improving current ones. A notable example is the NIH-funded Scientific Communication Advances Research Excellence (SCOARE) program at the University of Texas, which has been equipping faculty advisors in mentoring STEM trainees (via workshops) in science communication. The areas covered include “accommodating trainee linguistic differences, giving actionable feedback, and developing strategies to increase trainee engagement in science communication.”^{33,34}

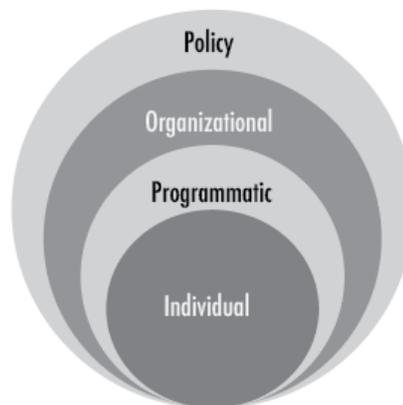


Figure 10: A visual element showcasing the developing clustering of recommendations around science communication and engagement training.

At the programmatic level, recommendations have highlighted the need for stronger partnerships, increased participant diversity, more coverage of training topics such as inclusive science communication, and more evaluation support, to name a few.^{16–18,22,35} Organizational-level recommendations continue to call for structural changes in universities and other institutions to prioritize public engagement with science as part of their core mission. Lastly, policy-level suggestions are collectively coalescing around the idea of formally incorporating public engagement training into degree programs and funding mechanisms.^{6,36} Given the insights gleaned so far from our landscaping and in light of the existing recommendations, we provide the following areas for action and questions for contemplation:

Action Area 1 (Training Developers): State the specific learning objectives on training initiative websites and provide a mechanism for participants to track skill development.

While general program descriptions provide an overview of a training initiative’s scope and aims, they often fall short of offering targeted guidance for prospective participants. To bridge this gap, it is crucial to go beyond general descriptions and clearly articulate specific learning objectives. These objectives should clarify the focus and scope of the training, which will enable participants to better understand what they are going to learn and how it aligns with their personal and professional goals (see example in Table 1). This transition from general to specific objectives will also assist with the evaluation process. Additionally, outside of formal university courses and degree programs, the time and effort invested by scientists in public engagement training is difficult to track and often goes unrecognized. To incentivize scientists to continue honing their skills in public engagement, training initiatives should also offer forms of recognition for participation. This could take various forms such as digital badges, certificates, or even integration into existing professional development tracking systems. Offering such tangible recognition would not only validate scientists’ skill development but also allow them to track the development of their skill sets over time. The question of creating a standardized mechanism for tracking and

incentivizing ongoing professional development in public engagement training is a topic that warrants further discussion.

- What are the advantages and disadvantages of instituting a centralized system, analogous to existing Continuing Medical Credits (CME),³³ that would allow participants to monitor the development of the diverse skill sets needed in public engagement?

Action Area 2 (Training Developers): Provide summary impact statements on training initiative websites.

Currently, there is limited availability of public impact data that reflects the efficacy of training initiatives in public engagement. We recommend that all training initiatives include a publicly available summary impact statement on their websites. These statements should succinctly describe the key outcomes and impacts of the training, such as skills gained, career advancements facilitated, and other impact information against the stated goals of the training (see examples in Table 2). Providing such impact statements could serve multiple purposes: It can guide participants in selecting a program that aligns with their goals, offer accountability for the program developers, and contribute to a body of evidence that can help evolve and improve the field at large. Additionally, summary impact statements can serve as a mechanism to navigate the delicate balance of intellectual property concerns (this applies to curricula as well). They allow training initiatives to share essential information about their impact without having to reveal proprietary or sensitive details they would prefer to keep confidential.

- What types of metrics should be incorporated into impact statements to make them useful for stakeholders?

Action Area 3 (Universities): Create an institutional hub dedicated to public engagement with science that can serve as the coordinating entity for current and new initiatives.

To address the current challenge of internal coordination in public engagement training at universities, we recommend universities create an institutional hub dedicated to public engagement with science. This hub would serve as the nexus for various training initiatives, both new and existing, acting as a coordinating body to facilitate inter-departmental collaboration. One of the hub's key functions should be to maintain a comprehensive catalog of training initiatives. This centralized resource would enable the university to identify local gaps and highlight opportunities for cross-departmental collaboration. Universities should also provide dedicated funding not only for the hub itself, but also for the training initiatives, projects, and events it coordinates. Such financial commitment would act as a critical support, strengthening the development, implementation, and sustainability of public engagement efforts.

- What kind and level of staffing is needed to effectively manage and maintain the hub, and how could this be funded sustainably?

Action Area 4 (Funders): Provide more funding to support public engagement training.

To further drive innovation and sustainability, it is essential to provide more funding opportunities directed at public engagement training. One way is for funders to create more requests for proposals exclusively dedicated for public engagement training. This would act as a catalyst for innovation around several dimensions in public engagement training, such as evaluation, instructional design, recruitment strategies, and professional development. This focused approach enables the targeting of resources to areas that are most crucial for developing and enhancing public engagement training.

- How would grant calls specifically for training affect the growth and innovation of training activities in public engagement?

Next Steps

As we transition to the next phase of our project, Research!America with support from the Lasker Foundation will continue improving the dashboard with new elements and, where relevant, new metrics. This will be a user-driven process, allowing for the submission of new initiatives and data to be considered for inclusion. The overarching goal is not only to enhance the user interface but to crowdsource an even more robust understanding of the training landscape in public engagement. We also have plans to utilize diverse approaches to engage and strengthen connections between training developers, and to enhance the visibility and sharing of new information from and about public engagement training initiatives.

Acknowledgements

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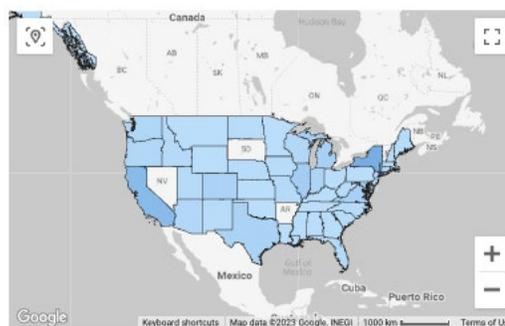
Dashboard Guide

The goal of the guide below is to provide an overview of the dashboard's functionality and to explain the coding behind some of the figures. Please note that the dashboard is subject to ongoing updates to ensure it remains a current and reliable resource. If you have any questions, suggestions, or would like to provide feedback, please send an email to Fanuel Muindi at fmuindi@researchamerica.org.

Potential Use Cases: The dashboard caters to a wide range of user interests and needs. For scientists and students, the dashboard can be used to discover and compare training opportunities that align with their academic and professional goals. University administrators and faculty members might utilize the dashboard to identify potential partnerships with their existing public engagement training programs. Policy advocates and funders can leverage the insights to understand the landscape better and inform their advocacy efforts and funding strategies. Additionally, training practitioners can use the insights from the dashboard to benchmark their programs.

General Functionality: The dashboard is built on Google's Looker data analytics platform and features a range of interconnected visual elements including graphs, charts, and tables. The dashboard is connected to a Google sheets file that hosts the raw data. Interconnected means that interacting with a parameter in one graph automatically updates others, offering an integrated data exploration experience. For instance, selecting a specific geographic region on the map will update all other graphs and tables to focus on that same region, facilitating more nuanced and meaningful queries. Additionally, users have the option to perform open-ended searches, which provides even greater flexibility in data querying. Users can also download summarized data directly from each figure for further analysis or take a snapshot of a given figure. Furthermore, the entire dashboard can be embedded on any external website. Below, we discuss some of the main visualizations in greater detail.

Map: The map visualization on the dashboard serves as a geographical representation of the training initiatives across the United States. It is important to note that for initiatives with multiple locations, the map only pinpoints their home base, which is generally the location of the institution hosting the training. This geographical information primarily reflects the distribution of institutions offering these trainings and should not be interpreted as a measure of the training's accessibility (in person, online, or hybrid) given there is another dedicated graphic with that information. Users can zoom in and out and click on specific locations for more detailed information. Interacting with the map will also automatically update other graphical elements and tables on the dashboard.

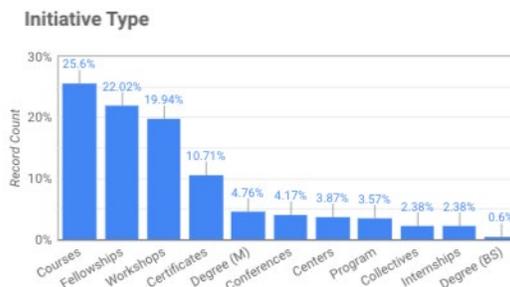


Search Bar: The open-ended search bar on the dashboard uses descriptions of training initiatives that were sourced largely from the “about” sections of their respective websites. Utilizing Looker's case-



sensitive search algorithms, the dashboard updates all dashboard elements to reflect data relevant to a user-inputted keyword, such as “storytelling.” Due to the case-sensitive nature of the search engine, a single keyword is advised for optimal query results.

Initiative Type: This reflects the framework/setting where the training is taking place. The categorization is as follows: conferences, workshops, courses, certificates, degrees (both master’s and bachelor’s), fellowships, centers, programs, and collectives. Wherever possible, the terms used to describe each type of initiative are derived from how these initiatives describe themselves on their respective websites. We make an active effort to distinguish individual courses, programs within broader training centers, and standalone workshops to offer more granularity. However, if a certificate program encompassed numerous courses and workshops, we opted to list the certificate as a singular entity. The same logic applies to degree programs that offer a multitude of courses. Listing those courses individually was not practical. This decision was made to balance the resources available and the informational needs of diverse stakeholders. Below is the breakdown and description of the taxonomy along with examples:

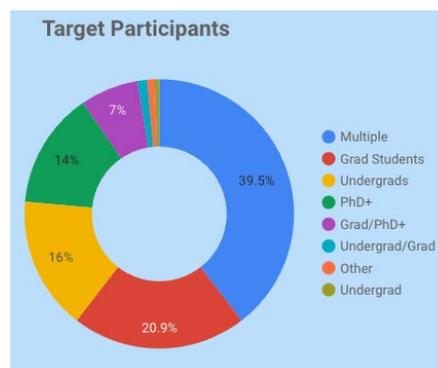


- **Conferences:** A structured event or gathering that could last a few days featuring a variety of activities such as workshops, keynote speeches, panel discussions, and networking sessions. External sponsors are common. Example: ComSciCon.
- **Workshops:** These can be standalone workshops and seminars ranging from a few hours to several days, focusing on a specific topic or skill set. Included terms: boot camp. Example: Scientific Communication Advances Research Excellence (SCOARE) faculty workshop (University of Texas MD Anderson Cancer Center).
- **Courses:** Generally found in course catalogs and offer structured, term-based educational experiences. Example: BIOG 3500 Introduction to Applied Science Communication: Digital Platforms and Public Engagement – Cornell University.
- **Certificates:** Programs that lead to a credential upon completion, designed to signify mastery in a particular area of study. Example: Science Policy & Advocacy Certificate Program for STEM Scientists – University of California, Irvine.
- **Degree (Master’s):** Formal educational programs/specializations at the graduate level that include course requirements and often a thesis or project. Example: Master’s in Science Communication, Alan Alda Center for Communicating Science, Stony Brook University.
- **Degree (Bachelor’s):** Formal undergraduate educational programs with course requirements. Example: Stevens Institute of Technology, Bachelor of Arts in Science Communication.
- **Fellowships:** Formally organized, time-bound experiences for which participants could be paid as employees and last several months to years. Examples: The STEM Communication Fellows Program – University of North Carolina-Charlotte and Rita Allen Foundation’s Civic Science Fellows Program.

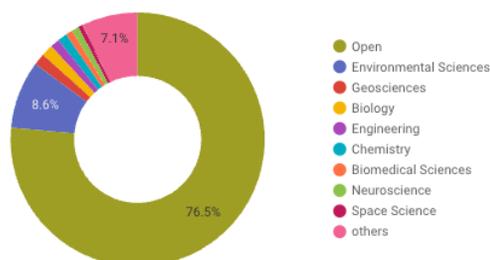
- **Internships:** Structured experiences typically for undergraduates lasting 1-3 months. E.g., Public Interest Internship Program at the Center for Science in the Public Interest.
- **Centers:** Institutes or hubs with personnel dedicated to ongoing research, training, and public engagement in the field. Example: The Center for Communicating Science at Virginia Tech. Where an institute offered a program, fellowship or internship, these individual training elements were listed.
- **Programs:** Broadly defined initiatives that may include various training formats and are typically organized around a core theme or objective. Example: Research!America's Civic Engagement Microgrant Program.
- **Collectives:** Student groups and professional networks that have training, resources, events, and other experiences around public engagement. Example: Science Communication Trainers Network.

Target Participants: There is a lot of variability in the nomenclature used to describe target audiences. We identified and clustered the terms into a few key categories:

- **Multiple:** A mixed audience category with more than three participant types (Example: “A graduate student, or within 10 years of having received your Master’s, PhD, or MD; An undergraduate or post-baccalaureate currently performing neuroscience research in a lab” – Society for Neuroscience Early Career Policy Ambassadors (ECPA) Program).
- **Undergrads:** Students who are currently pursuing undergraduate degrees.
- **Grad Students:** Students who are currently pursuing Master’s or PhD studies.
- **PhD+:** Holders of PhD degrees or related degrees including postdocs, faculty, staff researchers, and other professionals across fields.
- **Grad/PhD+:** A mixed-audience category catering to both graduate students and those with advanced degrees.
- **Other:** A category that focuses on other groups such as the public, high school students, etc.).



Scientific Field: We also mapped the scientific areas that each program might focus on. Interestingly, an overwhelming majority (77%) of these initiatives are categorized as “open,” indicating scientists across fields can participate in the offered training opportunity. For example, the [Science Communication Fellowship](#) at the City University of New York (CUNY) partners STEM graduate students and students from the CUNY Graduate School of Journalism’s health and science program to learn skills for effectively communicating science to the public.



Training Domain: We used the descriptions provided on the website to categorize the primary emphasis of the initiatives into areas such as science communication, science policy, community science, and other related fields within the broader scope of civic science.^{38,39}

Training Areas: The taxonomy for the training areas is inspired from Aurbach *et al.*, and Lewenstein and Baram-Tsabari.^{17,18} The public descriptions and curricula of training activities are qualitatively matched for the presence of the following categories:

- **Professional Development:** Covers career development, leadership, professional networking, and other terms related to advancing professionally.
- **Writing:** Encompasses science writing, creative writing, editing, reporting, blogging, and more.
- **Policy & Advocacy:** Covers policy engagement, development, science policy, legislation, policy analyses, advocacy, and other policy-related terms.
- **Multimedia Tools:** Covers social media, video, audio, podcasting, etc.
- **Oral Communication:** Includes public speaking, oral expression, gesture, posture, elevator pitches, and other related terms.
- **Conceptual Literacy:** Includes theory, history, scholarship, conceptual frameworks, and others.
- **Inclusion:** Includes diversity, culturally relevant pedagogy, intersectionality, equity, justice, and other similar terms.
- **Community Engagement:** Covers audience analysis, empathy, identity, listening, reflection, community science, and other related terms.
- **Ethics:** Covers the ethical considerations of public engagement in various contexts.
- **Visual Communication:** Covers data visualization, infographics, web design, graphics, and other related terms.
- **Evaluation:** Covers evaluation, assessment, and program evaluation terms.
- **Storytelling:** Covers storytelling, narrative, story analysis, and other related terms.
- **Project Design/Mgmt.:** Covers project management, design, entrepreneurship, fundraising, and other related terms.
- **Goal Development:** Covers strategy, goal setting, action plans, and other related terms.



- **Other:** Covers areas beyond the categories used above. These include risk communication, misinformation, trust, reducing polarization, persuasion, crisis communication, etc.

Date Added to the Dashboard: To assist users in monitoring the addition of new training initiatives to the dashboard, a dedicated graph illustrates the monthly inclusion of these initiatives. Users can click on the different months to see the initiatives.



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