Recommended strategies to integrate public engagement and civic science training into graduate STEMM education

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Research!America convened the Public Engagement Working Group to advise Research!America on strategic action steps needed to integrate public engagement and civic science training into graduate science, technology, engineering, mathematics and medicine (STEMM) education.

Led by co-chairs Alan Leshner, CEO Emeritus of AAAS, and Keith Yamamoto, Professor Emeritus and Vice Chancellor for Science Policy and Strategy at UCSF, the group engaged 26 members from academia and philanthropy. The group met between December 2023 and May 2024 for presentations and discussions to assist Research!America in developing recommendations for academic institutions, federal funders, and foundations. Those concrete steps, described in this document, will help ensure that all STEMM trainees have access to public engagement training.

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Why Public Engagement Training is Needed in Graduate STEMM Education and Beyond

We define public engagement with science as a multidirectional approach that provides opportunities for mutual learning among scientists and the public by building feedback loops that keep scientific research accessible and responsive to societal needs[1,2]. The skills involved are varied but are anchored around the ability to engage effectively with local community members, community leaders, and policymakers. Public engagement with science intersects with the broader umbrella of civic science, which includes science policy, STEMM equity, science ethics, open science, and more[3]. The multidirectional engagement with diverse groups that is a hallmark of public engagement with science is necessary not only for society to understand, trust, and support science, but also to ensure scientific excellence practiced with high ethical values.

While trust in science has declined, as it has for many institutions, trust in scientists remains strong overall[4]. Indeed, the public wishes and expects scientists to communicate their research to the public. According to survey research commissioned by Research!America, eight out of ten adults in the U.S. believe that it is part of the job of scientists to communicate their research and its impact on society to the public[5]. Furthermore, the public has a right to this information given their role as taxpayers.

Despite this perceived responsibility, scientists have typically been detached from the diverse groups – geographic, economic, racial, ethnic, gender, disabled – that comprise our nation. For example, confidence in scientists among U.S. adults varies by education and income, with higher levels of confidence correlated with higher education and income[6].

The COVID-19 pandemic, climate change, and other societal challenges, combined with the proliferation of misinformation and disinformation, amplify the importance – indeed the urgency – for scientists to engage with the public. However, many established scientists consider such engagement to lie outside of their roles and responsibilities, and certainly outside of their skillsets and training[7–9]. On the other hand, many early career scientists are eager to acquire the skills[10–12] for public engagement, centering around communicating with non-scientifically trained audiences such as policymakers. We propose that all scientists should receive public engagement training as part of their graduate studies, and consider the following strategic and tactical approaches toward that goal.

Strategy 1: Build Support in Academia for Public Engagement Training

A landscape analysis of public engagement training within academia revealed a scattering of typically under-resourced courses, certificate programs, conferences, internships, fellowships, and workshops[13]. Far from a coordinated ecosystem, most of these initiatives lack sufficient funding and staffing to develop curricula or tools for assessment and evaluation[14]. Institutional support, coupled with validation and investment from government and private funders (see below), is crucial for embedding public engagement training into graduate STEMM programs. Notably, such introductory training could be structured to have little or no effect on time-to-degree, as it would comprise a component of the course instructional phase of graduate training, which is typically measured in months of the overall >5 year STEMM graduate experience. Ultimately, dedicated funding and personnel with relevant expertise are both essential, as well as policies and infrastructure that ensure sustainability and alignment with the institution's broader educational and research goals and mission.

<u>Recommended Actions at Universities</u>

- **Declare public engagement training a priority**. Convince institutional and faculty leaders that public engagement training is a priority. Their endorsement will help lead the effort.

- **Policy review:** Review and revise institutional policies to ensure that public engagement activities are well recognized and considered in allocating resources, setting strategic priorities, and evaluating faculty for tenure and promotion[15].
- **Departmental or Program resources:** Assign and support faculty and senior staff to oversee public engagement training activities in STEMM departments. These personnel can serve as strategic partners with STEMM programs to support the curriculum design and implementation of public engagement training initiatives for students and integration into existing graduate courses. They can also facilitate faculty involvement in public engagement activities. Examples of their responsibilities:
    - develop relationships with external organizations and provide resources to support experiential opportunities (such as internships and community projects);
    - assist and coordinate STEMM faculty in the preparation of external grants (*e.g.,* NSF AISL & NSF IGE) to support public engagement activities;
    - facilitate internal partnerships and engagements between STEMM programs and those centered on communication, journalism, public policy, community outreach and engagement, cooperative extension, and others around public engagement training and practice (*e.g.,* courses, symposia, workshops, *etc*.);
    - systematically track impact metrics for public engagement training initiatives (*e.g.,* satisfaction, pre/post skill development, confidence levels, products to, for, or with the public, *etc.)* to identify what's working, and facilitate the sharing and adoption of best practices;
    - leverage the developing frameworks of core competencies in science communication to design training curricula that help scientists acquire the essential skills and knowledge needed to engage their local communities[10,11];
    - provide guidance to faculty on employing institutional resources to cite public engagement as fulfillment of NSF Broader Impacts requirements.

- **Faculty Support for Trainees**: Faculty should acknowledge the importance of public engagement and encourage graduate students and postdocs in their labs to participate in public engagement training courses and include public engagement activities in grant opportunities such as NSF GRFP and NIH F31/F32 NRSA to support the overall development of trainees as scientists.

Strategy 2: Leverage Federal Funding for Public Engagement Training

Certain federal graduate research training programs (e.g., the NIH Ruth L. Kirschstein National Research Service Award, Institutional Research Training Grants (T32), and the NSF Research Traineeship (NRT) program) permit funding of public engagement skill-building. Additionally, the merit criteria employed in review of all NSF proposals include Broader Impacts for society, in principle covering graduate training that promotes public understanding of and engagement with science. Unfortunately, these existing resources are rarely tapped to support public engagement due to the absence of explicit guidelines and incentives. This should be rectified, eventually (see recommendation below) attaching a requirement for public engagement training as a condition for award of these grants.

The federal government should also consider deploying a strategy analogous to NIH's Broadening Experiences in Scientific Training (BEST) program[16] to incentivize universities to develop public engagement content. Under BEST, 17 institutions were funded to conceive, implement, and evaluate career exploration curricula that subsequently served as an array of tested models for adoption or adaptation by other universities.

Recommended Actions for federal funders

- Phase-in a requirement for public engagement training, initially to include only graduate students appointed to federal training grants such as the NIH T32 and NSF NRT. Staffing and support for training workshops, resource materials, and mentorship would be scaled appropriately; eventually, all graduate students would be required to complete training in public engagement.
- Utilize NSF Dear Colleague Letters (DCLs) and NIH Notices of Special Interest (NOSIs) to encourage the integration of public engagement activities through existing grant mechanisms and provide the necessary guidelines for such activities.
- Reviewers of NIH T32, NSF NRT, and other federal training grant mechanisms that include public engagement components should be familiarized with the importance and value of graduate trainees acquiring high-quality public engagement skills.
- As noted above, a closed-end grant mechanism modeled after the NIH BEST program should support the development and testing of innovative curricular approaches that embed public engagement into research training[16]. This exercise would produce exemplary models that can be adopted or adapted by other institutions, facilitating the broad implementation of effective public engagement practices across STEMM fields and organizations.
- Interagency coordination around public engagement through a centralized office, as recommended in the 2023 letter by the President's Council of Advisors on Science and Technology (PCAST), would synergize efforts and foster opportunities for mutual learning[17,18].

Strategy 3: Leverage Philanthropic Funding for Public Engagement Training

Foundation support has been central to the call for awareness and action on the importance of public engagement and broader civic science. As independent entities committed to supporting science for the benefit of humanity, philanthropies are increasingly energized and well-positioned to address this at a systems level. With their unique flexibility and strategic agility, philanthropic organizations could be pivotal in shaping the landscape of graduate STEMM education by experimenting with public engagement training initiatives that would set precedents and provide models for federal funding mechanisms. Philanthropy can be a partner in convening and connecting to reduce duplication of efforts and facilitate shared learning and resources, as well as to help bridge perspectives from academia, public institutions, industry, nonprofits, and diverse communities.

Recommended Actions for philanthropic funders

- Grant mechanisms should be created to support current and new public engagement training initiatives for STEMM trainees and faculty, in addition to providing the necessary resources or support for conducting public engagement. This would increase the pool of available funding, while also generating new models and approaches.
- Public engagement components should be included in existing research grant mechanisms. Formal guidelines will help applicants understand how to add public engagement activities (training and/or practice) into the goals of their scientific projects.
- Additional support is needed for research on the pedagogy of teaching public engagement skills to understand what works, what doesn't, and what metrics are the best predictors of impact.

Setting the Stage for the Next Phase

The strategies and recommended actions shared here provide a roadmap for the next phase of this work where we will continue to engage leaders from academia, philanthropy, and government to initiate implementation. We believe that the inclusion of public engagement training in graduate STEMM curricula will foster a scientific culture that not only advances knowledge but also serves and evolves with the diverse communities it aims to benefit.

Footnotes

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