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Editorial

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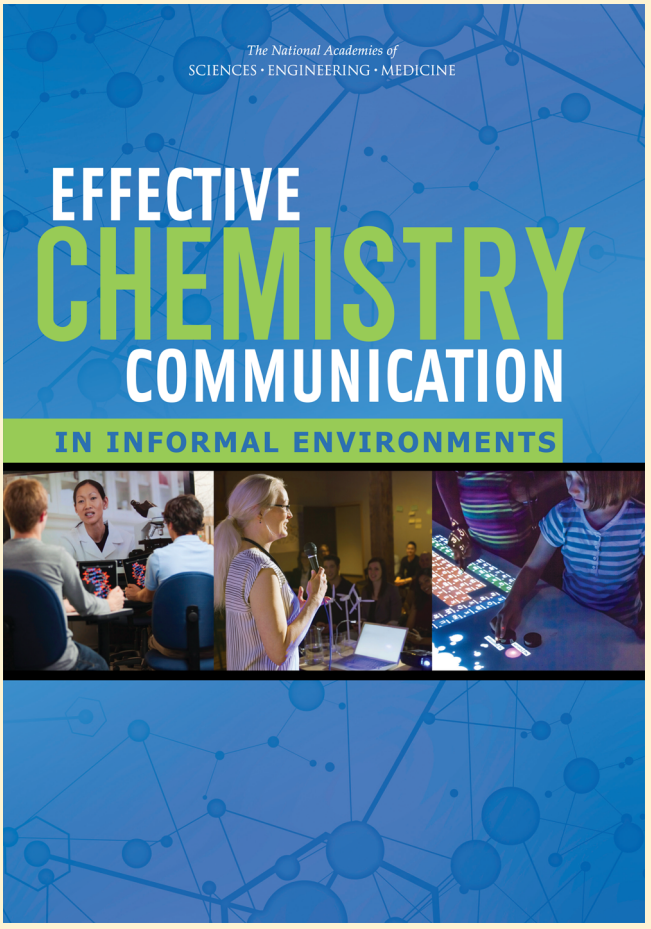
Communicating Chemistry in Informal Environments: A Framework for Chemists

Mary M. Kirchhoff*

Education Division, American Chemical Society, Washington, DC 20036, United States

ABSTRACT: Many chemists engage in outreach activities through their companies, colleges and universities, government laboratories, and ACS local sections. Sharing research findings, developing better-informed citizens and consumers, and inspiring future generations of chemists and chemical engineers are factors that motivate chemists to engage with the public. Yet most chemists receive little training in effectively communicating with the public. A recent report by the National Academies, *Effective Chemistry Communication in Informal Environments*, offers a framework to guide chemists in engaging with the public. This framework not only provides structure to communication activities, it is also intended to encourage chemists to engage with the public.



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Outreach. Public engagement. Science communication. These are just a few of the terms used to describe interactions between scientists and the public. Scientists have a long history of sharing their research results and enthusiasm for science with nonscientists. For example, the Christmas lectures introduced by Michael Faraday at the Royal Institution in 1825 are legendary.[1] Not everyone, however, is as gifted a lecturer as Michael Faraday, and modes of communicating science have greatly expanded beyond the lecture over the past two centuries. How do scientists know if their public communication efforts are effective?

A recent National Academies' report on *Effective Chemistry Communication in Informal Environments*[2,3] provides guidance to chemists in planning, conducting, and assessing chemistry communication activities. This report builds upon the findings of other Academies' studies on informal education and science communication.[4−8] In developing this report, the Committee on Communicating Chemistry in Informal Settings characterized current efforts at communicating chemistry, synthesized social science research on effective communication, and developed a framework of evidence-based strategies to design chemistry communication activities. This two-part report presents a framework, and the research base underpinning the framework, for engaging in effective chemistry communication, accompanied by a stand-alone guide that offers practical advice for designing and evaluating communication activities.

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Chemistry communication takes many forms, from national and international activities, such as the American Chemical Society's National Chemistry Week[9] and the 2011 International Year of Chemistry,[10] to local events such as science cafés and hands-on activities at a science museum. Chemists engage in such activities for a variety of reasons; on a practical level, some chemists do so in addressing the broader impacts requirement of National Science Foundation grants. The *Effective Chemistry Communication* report identifies four primary motivations of chemists who engage in public communication, which are to

1. Increase public appreciation of and excitement for chemistry as a source of knowledge about the world
2. Develop scientifically informed consumers (i.e., consumers will be able to use chemistry information to make decisions or solve problems)
3. Empower informed citizen participation in democratic processes
4. Encourage workforce development in the chemical sciences

When communicating chemistry in informal settings, chemists act as sources of content and credibility, as well as bridge builders between universities, industry, other sectors of the chemistry enterprise, and the public. Participating in chemistry communication activities is a unique form of professional development that enables chemists to enhance their ability to share complex topics with the public while learning about the public's perceptions and concerns about issues such as climate change, nanotechnology, and water quality. The recent water crisis in Flint, Michigan, highlighted the need for better public (and public officials') understanding of chemistry.[11,12]

The framework for the design of chemistry communication activities consists of five elements:

Element 1. Set communication goals and outcomes appropriate for the target participants.
Element 2. Familiarize yourself with your resources.
Element 3. Design the communication activity and how it will be evaluated.
Element 4. Communicate!
Element 5. Assess, reflect, and follow up.

While *Effective Chemistry Communication* is focused on chemistry, these five elements should be broadly applicable to communication within other scientific disciplines.

The framework leads chemistry communicators through a series of guiding questions addressing these elements. At the core of effective design is the question "Who are my participants?" because it places the goals and needs of the participants first. The nature of the communication activity may be limited by space and resource constraints, but partnerships with other organizations can offer additional options with respect to venue, materials, and funding opportunities. And of course safety must be at the forefront when engaging participants in hands-on activities.

The need to evaluate communication activities may seem intimidating, as many chemists do not have expertise in assessing informal activities. Considering evaluation during the planning stages of an activity or event is useful in achieving the intended goals and desired outcomes. Evaluation does not need to be complex, but should be scaled for the audience and level of activity. A show of hands or a short exit survey may be appropriate for a science café at a local coffee shop, while a more formal evaluation involving an experienced evaluator may be desirable for a longer-term activity, such as an after-school program at a Boys and Girls Club. Evaluation of communication activities can help improve the activity the next time it is presented, and provides useful data on "what works" that can be shared with other science communicators.

In fulfilling its charge, the committee found few research studies on chemistry communication. Consequently, the report recommends "Chemists and experts in empirical approaches to science communication, informal learning, and chemistry education should collaborate to study chemistry communication in informal settings."[2] The committee recommends that such collaborations should focus on three priority areas: (i) public perceptions and understanding of chemistry; (ii) digital media; and (iii) chemistry research and education policy. The chemistry education research tools applied to learning in classroom settings may be applicable to communicating chemistry in informal settings.[13,14]

In its 2012 report *Responsible Conduct in the Global Research Enterprise*, the InterAcademy Council noted:[15]

> *The public's trust in research depends on the honesty, openness, and objectivity of researchers in communicating their results of research to those outside of the research community. This responsibility can take time away from research, but public communication is essential given the pervasive influence of research on the broader society.*

Members of the public have unprecedented access to scientific findings thanks to digital communication, and people are recognizing the role of science in such global issues as energy, health, and the environment. Communicating chemistry is the responsibility of every chemist, and *Effective Chemistry Communication in Informal Environments*[2,3] provides timely guidance on how to do so effectively.

AUTHOR INFORMATION

Corresponding Author

*E-mail: m_kirchhoff@acs.org.

Notes

Views expressed in this editorial are those of the author and not necessarily the views of the ACS.

Mary Kirchhoff is Director of the American Chemical Society's Education Division, which serves learners and educators by building communities and providing effective chemistry education products, services, and information. She was a member of the Committee on Communicating Chemistry in Informal Settings that conducted the study on which the *Effective Chemistry Communication in Informal Environments* report is based.

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REFERENCES

(1) Royal Institution. *History of the Christmas Lectures*. http://www.rigb.org/christmas-lectures/history (accessed May 2016).

(2) National Academies of Sciences, Engineering, and Medicine. *Effective Chemistry Communication in Informal Environments*; The National Academies Press: Washington, DC, 2016; DOI: 10.17226/21790.

(3) National Academies of Sciences, Engineering, and Medicine. *Communicating Chemistry: A Framework for Sharing Science: A Practical*

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J. Chem. Educ. XXXX, XXX, XXX−XXX

Evidence-Based Guide; The National Academies Press: Washington, DC, 2016. DOI: 10.17226/23444.
(4) National Research Council. *Learning Science in Informal Environments: People, Places, and Pursuits*; The National Academies Press: Washington, DC, 2009; DOI: 10.17226/12190.
(5) National Research Council. *Surrounded by Science: Learning Science in Informal Environments*; The National Academies Press: Washington, DC, 2010; DOI: 10.17226/12614.
(6) National Research Council. *Identifying and Supporting Productive STEM Programs in Out-of-School Settings*; The National Academies Press: Washington, DC, 2015; DOI: 10.17226/21740.
(7) National Research Council. *Chemistry in Primetime and Online: Communicating Chemistry in Informal Environments: Workshop Summary*; The National Academies Press: Washington, DC, 2011; DOI: 10.17226/13106.
(8) National Research Council. *The Science of Science Communication II: Summary of a Colloquium*; The National Academies Press: Washington, DC, 2014; DOI: 10.17226/18478.
(9) American Chemical Society. About National Chemistry Week. http://www.acs.org/content/acs/en/education/outreach/ncw/about.html (accessed May 2016).
(10) United Nations. Celebrating the International Year of Chemistry. http://www.un.org/en/events/chemistry2011/ (accessed May 2016).
(11) Schnoor, J. L. Recognizing Drinking Water Pipes as Community Health Hazards. *J. Chem. Educ.* **2016**, *93* (4), 581−582.
(12) Torrice, M. How Lead Ended Up in Flint's Tap Water. *Chem. Eng. News* **2016**, *94* (7), 26−29.
(13) Christian, B. N.; Yezierski, E. J. A New Chemistry Education Research Frontier. *J. Chem. Educ.* **2012**, *89* (11), 1337−1339.
(14) Kuntzleman, T. S. National Chemistry Week: A Platform for Scholarship. *J. Chem. Educ.* **2015**, *92* (10), 1585−1588.
(15) InterAcademy Council. *Responsible Conduct in the Global Research Enterprise: A Policy Report*; InterAcademy Council, IAP: Amsterdam, The Netherlands, 2012; ISBN: 9789069846453.

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