Helping Scientists Become Effective Partners in Education and Outreach

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How does a scientist find herself standing before a group of lively third-graders? She may be personally motivated—seeking to improve public understanding of scientific issues and the nature of science, or to see her own children receive a good science education—or perhaps she simply enjoys this kind of work [*Andrews et al.,* 2005; *Kim and Fortner,* 2008].

In addition to internal motivating factors, federal funding agencies have begun to encourage scientists to participate in education and outreach (E/O) related to their research, through NASA program requirements for such activities (see "Implementing the Office of Space Science Education/Public Outreach Strategy," at http://spacescience.nasa.gov/admin/pubs/edu/imp_plan.htm) and the U.S. National Science Foundation's increased emphasis on "broader impacts" in merit review of research proposals (see http://www.nsf.gov/pubs/2003/nsf032/bicexamples.pdf). Universities, laboratories, and large collaboratives have responded by developing E/O programs that include interaction between students, teachers, and the public in schools; after-school and summer programs; and work through science centers, planetaria, aquaria, and museums.

The need is large: Most citizens are interested but ill informed about science. Making wise decisions about daunting societal and environmental problems requires understanding both scientific concepts and the limits of scientific knowledge. Scientists can assist by offering expertise, data, equipment, and other resources; by advocating for strong science education in the schools; and by sharing exciting and true stories of exploration, discovery, and persistence [*Bybee and Morrow,* 1998]. Scientists who are college instructors have additional roles in encouraging talented students to pursue science and engineering and in strengthening the science preparation of future teachers. For these reasons, effective participation in education and outreach is an increasingly important professional expectation of scientists, one that requires specialized skills and knowledge but for which most scientists have little preparation.

Many projects—a list too lengthy to review here—have developed local expertise and specific models for involving scientists in education. A new program, Resources for Scientists in Partnership with Education (ReSciPE), has sought a more general empirical understanding of how best to engage and prepare scientists for such work through a twofold strategy: offering professional development opportunities to working scientists who are engaged in education, and then studying these scientists to learn how to better support their E/O work.

A ReSciPE for Success

Training in education and communication is becoming more available to undergraduate and graduate students in the sciences. However, most working scientists today did not have access to such training. Most have little knowledge of school curricula, standards, and best practices in science education, or of the issues that face teachers and schools. They may not know how to select age-appropriate topics or adjust presentation styles for nontechnical audiences. These gaps in understanding can inhibit communication with students, teachers, and the public [*Kim and Fortner,* 2007; *Tanner et al.,* 2003], thus diminishing the impact of the time and resources scientists invest in E/O. Conversely, feeling that their work has a positive impact contributes to the likelihood that scientists will persist in E/O work [*Andrews et al.,* 2005].

ReSciPE seeks to address this issue by offering professional development opportunities to working scientists who are engaged in education. In the past 3 years, more than 400 scientists and their education collaborators have attended 18 workshops given across the United States at scientific laboratories and conferences. Our typical workshop participant is a research scientist in a government lab or university who participates in E/O for a few hours each month. Many graduate students and postdocs also attend.

ReSciPE's introductory workshop, "Scientific Inquiry in the Classroom," focuses on inquiry as a best practice in science education that scientists can both understand and enhance by drawing on their own experience of investigation [*Thiry et al.,* 2008]. Participants consider the educational research base that supports inquiry-based approaches to teaching and learning [*Bransford et al.,* 1999] and engage in hands-on, minds-on activities that provide firsthand experiences of inquiry-based science.

Drawing on the dual definitions of inquiry in the National Academy's *National Science Education Standards* [see *Olson and Loucks-Horsley,* 2000], the workshop shows scientists how their own deep understanding of investigation is a crucial resource to share with nonscientists. Through activities such as the "black box" [*Delta Education,* 2008] and the "Mystery of the Iceman" [*Biological Sciences Curriculum Studies,* 2006], workshop participants see examples that show science as a process of developing knowledge that emphasizes gathering evidence and testing alternate explanations. According to interviews with scientists, the "inquiry wheel" [*Reiff et al.,* 2002; *Harwood,* 2004] (see Figure 1) graphically summarizes this process in a more realistic manner than the traditional, linear scientific method. In their E/O work, scientists can foster understanding of the nature of science by emphasizing the intellectual and social processes of science and by engaging audiences in question posing and puzzle solving, rather than emphasizing only the final answers obtained.

Also developed in the workshop is the idea of inquiry as a teaching and learning strategy for addressing the "big ideas" of the Earth, space, life, and physical sciences. Through video clips from a master physics teacher's classroom [*WGBH,* 2000], participants see how students can develop a solid understanding of difficult concepts in optics by engaging with a question, examining and evaluating evidence, and drawing and presenting conclusions. Scientists can use similar approaches to teach scientific concepts in their classroom and outreach work.

A Framework for Professional Development

Evaluation results from surveys and interviews show that ReSciPE workshop participants leave with increased willingness to

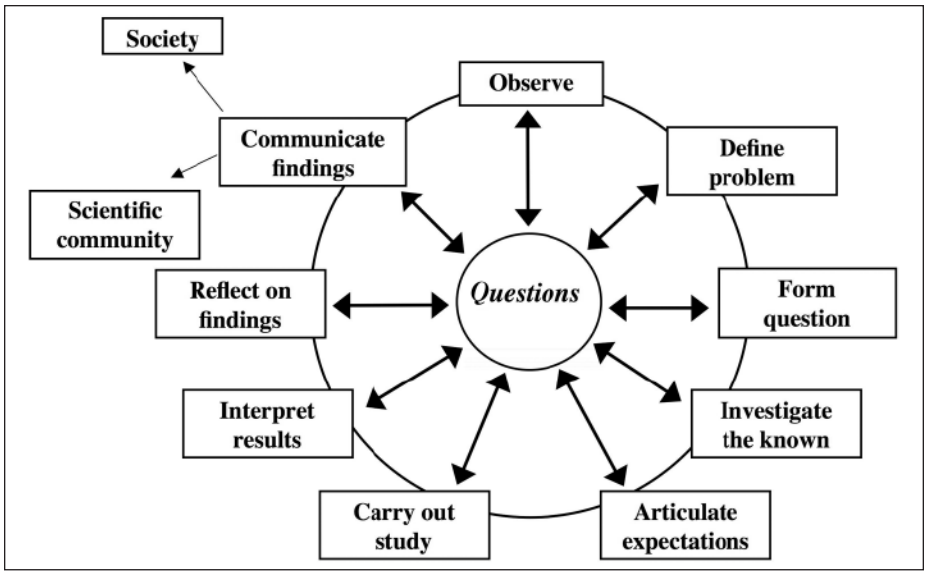

Fig 1. The inquiry wheel, an alternative to the linear scientific method. Image from Harwood *[2004], redrawn from* Reiff et al. *[2002].*

participate in education, better understanding of inquiry as an effective practice in science education, and greater awareness of other learning that would benefit their E/O work. The workshop does not prepare scientists to participate in a specific E/O program—rather, it offers inquiry as a framework for considering how scientists can support science education across a wide range of venues, whether a schoolroom presentation, teacher institute, or public lecture. Follow-up interviews show that this approach resonates with scientists, who draw on the workshop material to reshape their own E/O work.

In addition to these positive outcomes for participants themselves, the study also offers general knowledge that can assist E/O providers in training scientist collaborators for E/O work. Using data from surveys and interviews with workshop participants, the ReSciPE research team has developed a framework that organizes scientists' professional development needs, from initial recruitment into participation in education-related professional development, to the professional development activity itself, and finally, follow-up support [*Thiry et al.,* 2008; *Laursen et al.,* 2008]. To fully meet scientists' professional development needs, recruitment should address scientists' motivation and access to training; the professional development activity itself should provide useful knowledge and skills relevant to scientists' own E/O activities and engage them with other perspectives on E/O; and follow-up should offer practical help, collaborative opportunities, and public support from higher administrators to encourage continued involvement in E/O. Such a framework can be applied when E/O providers plan targeted professional development to support their own local initiatives.

ReSciPE welcomes queries from projects interested in hosting a professional development workshop for their participating scientists. To learn more, visit http://cires.colorado.edu/education/k12/rescipe, or contact us at rescipe@cires.colorado.edu.

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GEOPHYSICISTS

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Honors

U.S. President-elect Barack Obama has selected **Jane Lubchenco** as his choice to be administrator of NOAA. Lubchenco currently is professor of marine biology and zoology at Oregon State University, Corvallis.

Seven AGU members were recipients of the 2007 Presidential Early Career Awards for Scientists and Engineers, announced by the White House on 19 December. They are **Kim M. Cobb**, Georgia Institute of Technology, Atlanta; **Charles Kankelborg**, Montana State University, Bozeman; **Anna M. Michalak**, University of Michigan, Ann Arbor; **Yi Ming**, NOAA; **Merav Opher**, George Mason University, Fairfax, Va.; **Purnima Ratilal**, Northeastern University, Boston, Mass.; and **Enrique R. Vivoni**, New Mexico Institute of Mining and Technology, Socorro. The awards are considered the U.S. government's highest honor for professionals at the outset of their independent scientific research careers.

In Memoriam

Sidney Kaufman, 100, 23 October 2008, Seismology, 1961