♦ Teaching Key Groups to Communicate Science to Nonspecialists

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Journalists and scientists can increase their skill in popular science communication in various ways. Also, various resources and approaches exist for use in teaching popular science writing. A session to help scientists learn to work more effectively with reporters can well center around certain key suggestions.

Much as publishing successful journal articles requires both authors and editors to be suitably skilled, communicating science effectively to nonspecialists calls for appropriate abilities on the part of both scientists and professional communicators. Opportunities now exist for instruction not only in scientific writing and editing, but also in popular science communication.

This article begins by identifying some groups that can benefit from instruction in popular science communication and discussing some channels for such instruction. Next, it provides guidance in developing and delivering a course in popular science writing. Finally, it presents material for a session in which scientists are taught how to respond effectively to reporters' requests for information. The article is intended to help biology editors and others foster the successful communication of science to the public.

Before proceeding, 2 notes about terms are offered. First, "science writing" denotes writing intended for one or more segments of the public. In contrast, "scientific writing" is for, and typically by, scientists. An example of science writing is a science article in a newspaper; an example of scientific writing is a scientific paper in a journal. Second, in the current article, "science" will be used broadly to include not only science per se, but also technology and medicine.

Who, What, Where, When, Why

At various stages in their educations and careers, both journalists and scientists can benefit from instruction in communicating science to the public. In journalism, not only science reporters need to have a command of this realm. Good coverage of nearly any beat—be it politics, business, or even lifestyle or sports—includes gathering, analyzing, and presenting scientific or technical information. Also, many who have studied journalism or related fields work in public information or public relations for government agencies, academia, or corporations. Often, their work entails presenting research results or other scientific information to reporters or directly to the public—or editing such material.

Thus, nearly any journalism student can benefit from instruction in popular science communication. Although crowded curricula, limited availability, and limited interest prevent many students from taking courses devoted solely to this field, material in it can be readily integrated into more general courses. For example, in an information-gathering course, I have given a guest session on gathering scientific information; in a general-reporting course, I have spoken on basics of science reporting; and in my magazine-writing class, I routinely discuss writing magazine articles on science.

For those seeking more extensive instruction, various colleges and universities offer courses and degree programs in popular science writing. Many such offerings are listed in the periodically issued *Directory of Science Communication Courses and Programs in the United States* (1). Among institutions with master's level programs in popular science writing are New York University, Boston University, The Johns Hopkins University, and Texas A&M University. The University of California, Santa Cruz, has a science-writing certificate program specifically for individuals with science degrees and research experience.

Of course, education does not end with graduation. Somewhat as the Council of Biology Editors provides continuing education for those in scientific editing and related fields, the National Association of Science Writers (NASW) helps orient and update those who have entered popular science writing through either choice or chance. NASW has a highly substantive newsletter, *ScienceWriters*. In recent years, NASW's annual meeting, held in concert with the annual meeting of the American Association for the Advancement of Science, has expanded to include a variety of instructional sessions. Ongoing instruction also is available through the newsletter and meetings of the Society of Environmental Journalists. General professional organizations in journalism and public relations sometimes include material on science communication in their meetings and publications.

Optimal presentation of science to the public requires more than well-versed, conscientious professional communicators. It also requires the effective collaboration of scientists. Thus, instruction in communicating science to the public is rightly part of a scientist's education.

For the scientist-in-training, such instruction can take many forms. An undergraduate or graduate course in science journalism makes a fine elective; as well as giving future scientists insights and abilities useful in working with reporters and in presenting science to the public themselves, such courses foster writing skills that aid in preparing scientific papers and grant proposals. A session on popular science communication, either by the instructor or by a guest speaker, can fit well in a graduate or postgraduate course mainly on writing scientific papers. Likewise, it can fit well in a seminar series introducing graduate students to the culture of a scientific discipline. Sometimes training in working with the media is included in postdoctoral fellowship programs—for example, in public health.

Role modeling is another important

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means through which future scientists can learn how to present science to the public—and can learn to value such communication. A faculty member in science who is mentoring students should share with them experiences in working with the media and involve them in other popular-communication activities such as talking with lay groups. Also, to help ensure that new scientists have basic skills in popular communication, graduate committees should require students to explain their research in lay as well as technical terms.

Opportunities also exist for established scientists to enhance their ability in popular science communication. Various guides, some of which (2-6) are listed at the end of this article, have been published at least in part for this purpose. Public information professionals at scientists' institutions also can provide guidance. Meetings of professional organizations in science and related fields sometimes include sessions on communicating with the public. At scientists' institutions, sessions on popular science communication can be integrated into ongoing seminar series; instruction in this context may attract more scientists than would freestanding lectures on the topic.

For both journalism students and science students, internships are available in popular science communication. *Science* magazine, *Science News, The Sciences,* and other publications offer internships in science journalism. Internships in public information or public relations also exist at various scientific and medical institutions. Each summer for more than 20 years, the American Association for the Advancement of Science Mass Media Science and Engineering Fellows Program has placed advanced science students at various print and broadcast media sites. Similarly, the American Physical Society has established a program in which physics students spend a summer working for the popular media.

In short, students and professionals in both communication and science can benefit from instruction in popular science communication. As noted above, many channels and resources are available for such instruction. However, the need for such instruction remains only partially met. The rest of this article provides some guidance for helping to meet this need.

How: Teaching a Course in Popular Science Writing

Biology editors and those in related fields sometimes are called on, or feel the call, to teach popular science writing. What topics might a course in this area cover? What resources might be drawn on? What writing assignments might be useful? Such questions are addressed below. Some of the answers can aid in giving not only courses but also individual sessions on the topic, for example, as part of a scientific-writing course or departmental seminar.

Courses in popular science communication can vary considerably in scope. Given my interest in the print media and my appointment in a journalism department, my science-writing courses deal largely, though not exclusively, with writing articles for newspapers and magazines. Other areas that can be addressed include presenting science through the broadcast media and through new media such as the World Wide Web, conducting public relations and public information activities in science, preparing patient-education materials, and presenting science to the public through settings such as museums.

Class composition can vary widely. Students who take courses in science writing include those specializing in science, communication, and other fields; they range from undergraduates to graduate students to mid-career professionals. Some instructors have said their courses tend to work best when the group is relatively homogeneous. However, I enjoy teaching a diverse group and find that members often learn much from one another. Classes should be kept small, if possible—no more than about 15 members—to promote discussion and permit detailed feedback on writing assignments.

Areas to cover depend in part on the emphasis of the course. Topics discussed early in my science-reporting course include newsworthiness in science and basic writing techniques that can aid in presenting science clearly and engagingly to the public. The course also deals with gathering information through various, often interrelated channels—including scientific journals, institutional sources, conferences, interviews with scientists, and the Internet—and with evaluating that information. Among other areas addressed are genres of science writing, organizations in science writing and related realms, career options in popular science communication, and ethical issues in this field.

Various resources can be drawn on for teaching popular science communication. Perhaps the most important are examples, examples, examples of good science writing. (It's impressive how contagious good writing can be.) Examples of bad science writing can be instructive as well. For those teaching science writing, the time spent identifying apt examples is well invested. Efficient sources of material include the anthology *The New Science Journalists* (7), which contains pieces of science writing that are especially well researched, well crafted, or thoughtful.

Other works to draw on or assign include some (3, 4) of the books cited above that supply general guidance in science writing. *News & Numbers* (8) helps journalists and journalism students understand and evaluate statistics and study design. Although out of print and somewhat out of date, *Scientists and Journalists: Reporting Science as News* (9) provides good description and analysis of the science-writing field. The National Association of Science Writers book *A Field Guide for Science Writers* (10) promises to provide both instruction and perspective. Additional works to consider are listed in the science-writing bibliography in this issue of *CBE Views* (11).

Guest speakers and field trips can add much to science-writing courses. Speakers can include science reporters from various media; science writers at universities, government agencies, healthcare institutions,

and technology-oriented companies; and freelance science writers. Field trips to relevant libraries can help students overcome their intimidation regarding this resource. A field trip to a science museum can be enjoyable and enlightening.

Of course, writing assignments are a crucial part of a science-writing course. Progressing from assignments that are relatively short and simple to those that are longer and more complex typically works well. Early assignments can include an explanation of how something works, a brief news story or press release based on a journal article, a book review, a short article drawn from an in-class "news conference", and a description and evaluation of a World Wide Web site useful to science writers. The skills in gathering and presenting information developed through such exercises can then be combined in assignments such as a profile of a scientist or a feature article on a topic or issue in science. Providing opportunities for students to publish their work helps motivate the class and can enhance students' portfolios.

For writing assignments to be most effective, students should receive extensive feedback, including both identification of strengths and suggestions for improvement. Providing opportunity to revise their work helps students assimilate feedback, and it simulates a professional environment. Feedback can come not only from the teacher but also from fellow students, in the form of small-group discussions or written constructive critiques. Such critiques can be excellent assignments and can aid in identifying students well suited to become biology editors.

How: Giving a Session to Scientists

Biology editors and those in related fields can be well situated to address scientists on working effectively with the popular media. In the tradition of the CBE book *Scientific Writing for Graduate Students* (12), I present below what can be the core of a 30- to 60-minute session on responding effectively to reporters. The material comes mainly from a talk I gave to the Texas A&M University organization Women in Science and Engineering.

Early in the session, after an introduction geared to the audience, discuss the reasons (listed below) to work with the popular media. Ideally, elicit reasons from the group.

- If research is publicly funded, the public deserves to be informed about it.
- Science is an important part of our culture and thus should be shared widely.
- Members of the public need scientific and technical information to make sound decisions.
- Informing the public about science can help promote science and scientific institutions, can encourage people to seek scientific careers (including careers in science editing), can produce cross-fertilization between fields of science, and can be fun.

Then, devote most of the session to advice on being interviewed by reporters. Support the advice with examples, and obtain additional examples from the audience. Some possible suggestions to present are the following:

Find out what the reporter is seeking, and consider whether you are well qualified to respond. Especially if not well versed in science, reporters may have trouble determining which scientists are most suitable to interview. If you are not well qualified, decline the interview. If possible, refer the reporter to an appropriate source, or direct the reporter to the Media Resource Service, telephone 800-223-1730, which maintains an extensive database of scientists available to interview on given topics.

Check the background of the reporter. Decide accordingly whether—and, if so how—to proceed. Journalists seeking interviews from scientists range from general reporters with little science background to specialized science journalists with advanced degrees in science; their publications range from *Science* and *Science News* to supermarket tabloids. If the publication seems shaky, consider declining the interview. When you accept an interview, gear your remarks to the background of the reporter.

Realize that guidance is available in working with the media, and consider drawing on that guidance. Sources of such guidance include media relations offices at universities and other research institutions, publications such as some of those cited above, and some professional societies in science.

Recognize and work within reporters' constraints. For example, find out the reporter's deadline, and respond accordingly. Reporters for the daily media may have only hours—or less—to research a story. Saying that you will call back once the semester ends is likely to be of little use.

Respect reporters and their audiences. Reporters and their audiences may be ignorant of your field, but they are not stupid. Do not assume that they are knowledgeable about your field, but do not condescend. "Watering things down" tends to be ineffective and results in indigestible chunks in an insipid broth. A more appropriate image is that of building bridges between the audience's existing knowledge and the new material you are presenting.

Try to present material in a form suitable for direct presentation to the audience. For instance, use simple common language, provide examples, and present analogies. If you have visual materials or ideas for them, let the reporter know. The less translation the reporter must do, the more likely your information will be accurately conveyed.

Be concise and focused. Reports in the media must be brief, so concentrate on what is most important. When talking to broadcast reporters, try to provide some "sound bites". Do not say anything you would not want to see in print or hear on the air.

If there's a main message you consider important, be sure to present it. Particularly if they have little science background, reporters may not know some crucial questions to ask. Thus, take the initiative to present the key points if the reporter does not request them.

If possible, provide some material in writing. Doing so assists reporters and promotes accuracy. Depending on the reporter's background and your own constraints, the mate-

rials can include news releases, journal articles, or simply lists of key points. Fax machines and e-mail permit rapid provision of such materials to reporters almost anywhere.

To check reporters' understanding, have them repeat key points in their own words. A tactful way to do so is to say, for example, "I'm not sure I've explained this process clearly. Why don't you summarize it in your own words, so I can provide any needed clarification."

Offer to answer questions later. Sometimes important questions occur to reporters after the interview, and sometimes reporters find items unclear on reviewing their notes. Thus, offer to answer questions later; if appropriate, provide your home telephone number and your e-mail address. Often, e-mail can be an easy means of providing routine follow-up information.

Offer to review a draft for technical accuracy. However, do not demand that the piece receive your approval. Requiring that a piece meet your approval runs counter to journalistic practice, and unless the person interviewing you is on the public-relations staff of your institution, the demand for such review will almost surely be rejected. However, journalists increasingly are having their sources check material for technical accuracy. Limit your suggestions to technical content and, of course, present them with tact. Matters of style are in the journalist's domain, not yours—even if you are a scientist who is also an editor.

If work you have done may generate considerable media attention, plan accordingly. For example, if you are about to publish a newsworthy journal article, work with the public-information staff of your institution to prepare a news release. Be available for interviews. Seek tips from public-information staff and others about working effectively with the media while minimizing the disruption of your normal duties.

Have realistic expectations. Even the best, most accurate science reporting will not be as precise and detailed as a journal article. For example, it will not describe research methods in depth, and it may not mention your coauthors. However, it is likely to be much more effective than a journal article in communicating key points to general audiences.

Provide feedback, both favorable and unfavorable. If the reporter has done an exceptionally fine job, let the reporter know. Such feedback, as well as being welcome, helps promote skillful science reporting. If the story contains a serious error (which may have been introduced by the reporter or an editor), likewise inform the reporter. If possible, do so in a positive way, also noting strengths of the piece. Good reporters value feedback that can help avoid repetition of mistakes.

Conclude your sessions for scientists by addressing points of special interest or concern to the audience. In the case of Women in Science and Engineering, I discussed some possible pitfalls for women scientists being interviewed and also spoke briefly on writing for the public oneself. Of course, provide opportunity for questions and offer help in identifying other resources for learning to communicate science effectively to the public.

Closing Comment

Presenting science to the public is important. Presenting it well requires skill and effort on the part of writers, editors, and scientists. Directly or indirectly, may this article help inform and motivate these key groups.

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