1
Introduction

Increasing complexity and competitiveness in research environments, the prevalence of interdisciplinary and international involvement in research projects**,** and the close coupling of commerce and academia have created an ethically challenging environment for young scientists and engineers. For the past several decades, federal research agencies have supported projects to meet the need for mentoring and ethics training in graduate education in research, often called training in the responsible conduct of research (RCR). Recently, these agencies have supported projects to identify ethically problematic behaviors and assess the efficacy of ethics education in addressing them.

Congress and the public continue to pay attention to these issues, and the America COMPETES Act (HR 2272) of 2007 specifies that proposals for National Science Foundation (NSF) grants include mentoring for postdoctoral fellows and ethics training for graduate and undergraduate students in science and engineering.[1] The NSF guidelines also include a requirement that proposals for funds to support postdoctoral researchers include a description of mentoring activities. In light of the history of support for educating students and researchers in ethical or responsible behavior and the current political interest, this seems an appropriate time to review what we have learned so far and to identify directions for the future.

[1] The America COMPETES Act is accessible on line at *http://www.cfr.org/content/publications/attachments/2272.pdf*.

With support from the NSF, the National Academy of Engineering (NAE) Center for Engineering, Ethics, and Society (CEES) held the workshop "Ethics Education and Scientific and Engineering Research: What's Been Learned? What Should Be Done?" at the Keck Center of the National Academies in Washington, D.C., on August 25 and 26, 2008. The Division of Policy and Global Affairs (PGA) of the National Research Council (NRC) and the National Academies Committee on Science, Engineering, and Public Policy (COSEPUP), which has produced the third edition of *On Being A Scientist*,[2] provided advice and support for the workshop. *On Being a Scientist* is a guide that is widely used by academic institutions and faculty members to teach research ethics (e.g., issues related to publication and authorship, the use of human subjects in research, conflicts of interest, and intellectual property rights).

Many participants suggested that the workshop summary be organized around the themes of the panel sessions and discussions rather than chronologically, because these themes tended to come up repeatedly and participants in each session addressed a number of different themes. Thus readers will find that this summary focuses on themes rather than the chronology of presentations and discussion.

The summary follows, loosely, the thematic order of the workshop agenda (see Appendix). The first topic (Chapter 2), the social environment of science and engineering and ethics education, explores the context in which ethics mentoring and ethics education take place and the issues that context raises for future directions in ethics education. Chapter 3 focuses on the need for ethics education for graduate students and postdoctoral fellows in science and engineering. Chapter 4, on models for effective

[2] The third edition is available through the National Academies Press at *http://www.nap.edu/catalog.php?record_id=12192*.

programs, provides pragmatic guidance for academic administrators and research investigators who want to develop programs or activities in ethics education; this chapter includes information on instructional and institutional approaches to mentoring and ethics education. Chapter 5 is about assessment of approaches to ethics education. Chapter 6 is a summary of the discussions about next steps.

An ad hoc workshop planning committee helped develop the agenda and nominate participants. Members of the committee included physicist John Ahearne, NAE member and chair of the CEES Advisory Group and former director of the Ethics Program of Sigma XI, the honorary scientific society. Other members were University of California, Irvine biologist Francisco Ayala, a member of the National Academy of Sciences and a member of the committee that worked on the third edition of *On Being a Scientist*; astronomer Kathleen Flint, director of the Bring RCR Home Project of the National Postdoctoral Association; political scientist Mark Frankel, director of the Scientific Freedom, Responsibility and Law Program of the American Association for the Advancement of Science (AAAS); and psychologist Felice Levine, executive director of the American Educational Research Association.

Four of the five committee members attended the workshop and met with the CEES director after the first day to review progress. Levine then developed a thematic outline to help organize the discussion on the second day. Frankel and Levine also met briefly with Rachelle Hollander, CEES director, right after the meeting to go over material for this summary and plans for follow-up activities. Twenty-five people, as well as a number

of NSF observers, attended the meeting (for a list of attendees and committee members, see Appendix).

Four sessions, chaired by members of the planning committee, were held on the first day of the workshop: Needs and Issues for Ethics Education in Scientific and Engineering Research; Pedagogical Methods and Materials; Outreach and Assessment; and Review. The first three sessions opened with brief presentations and responses by workshop invitees. These were followed by group discussions on the topic of that session and related matters. The fourth session was a general discussion and review of the previous sessions. During lunch, a scenario used for ethics training was presented, followed by a discussion. Dinner included a talk about *On Being A Scientist*.

The second day began with a general discussion of next steps, chaired by the CEES director. The group was then divided into four smaller groups, two of which focused on the larger environment that affects scientific and engineering research and two of which focused on programmatic and assessment issues. The final session included reports on these discussions and a plenary discussion highlighting ideas for the workshop summary, again chaired by the CEES director.

Links to background materials from the workshop can be found on the CEES home page at ***www.nae.edu/ethicscenter***. These materials were provided by participants, who submitted citations and resources they thought attendees and others would find useful.[3] Most presenters and some respondents also submitted brief statements or PowerPoint slides that can also be found on the CEES home page.

[3] Persons and organizations with information about other resources should feel free to send their suggestions to CEES so they can be added to the list of resources and citations.