One of the most dramatic fears about science is that researchers will lie, cheat, or steal. Fraud is unacceptable for any type of research, but the potential for new technologies and therapies has ensured that the consequences of misconduct are most visible when it occurs in the experimental sciences. Although their history is relatively brief, it is relevant because these fields occupy much of ACS's focus. A case can be made that experimental science didn't really first come into its own until the seventeenth century, with one of its first and best-known practitioners being Galileo. Despite this history of only a few hundred years, it seems that widespread concern about the integrity of scientists did not surface until the 1970s. Have serious problems always been a part of science, but no one noticed? Are infrequent and minor problems now being blown out of proportion? Or has the integrity of scientists changed over the past three centuries? For a variety of reasons, we will probably never have definitive answers to any of these questions. However, it is still of some value to review what we do know about the terrain of scientific integrity.

It is possible that the history of experimental science coincides with a history of scientific fraud. Because they had reported results that were simply too good to be true, it has been alleged that even some of the most prestigious of scientists, including Galileo, Newton, and Mendel, committed research misconduct. In fairness, producing results that are too good to be true is not proof either that the findings were reported inaccurately or that the researchers knowingly misrepresented incorrect results. However, even if the allegations are true, it is worth reflecting on the differences between fabricating data in the seventeenth or eighteenth century to prove something that turned out to be correct, and doing so in the twenty-first century to prove something that may or may not be validated at some point in the future. The obvious answer is that reporting something today that you know to be untrue is flawed both on ethical and practical grounds.

Ethically, it is no longer possible to argue that we are unaware of the risk that...
C continued from page 1

our biases might lead us to false conclusions or bad choices. While the importance of experiments is obvious today, it may not have been as clear 300 years ago, when the idea of experimental observation was still a new approach to understanding the world. Practically, it would be a serious mistake to ignore the very different academic environment of today. Precisely because so much attention has been focused on egregious behavior in science, it is increasingly unlikely that research fraud will escape notice. And once it is caught, the consequences of research misconduct can be severe.

In the past 30 years, numerous cases of research misconduct have been widely reported. In 1974, William Summerlin, an immunologist, was found to have marked black patches on the backs of white mice to give the appearance of successful transplantation of skin from black to white mice. In the 1980s, two high-profile research groups were accused of research misconduct, but were ultimately found guilty primarily of sloppiness. In 1985, Robert Slutsky, a cardiologist and radiologist, was found to have fabricated data for at least 12 manuscripts. In 2002, Hendrik Schön, a physicist, was discovered to have fabricated research findings in multiple publications. And most recently, Woo Suk Hwang, a veterinary scientist, and his research team were found to have falsely reported the successful creation of stem cell lines through a process of somatic cell nuclear transfer (SCNT) for a man- 

The first way in which scientific fraud causes damage is the risk that science will be derailed either because potentially valuable lines of inquiry might be abandoned, or conversely, flawed lines of inquiry might be embraced. For example, many research groups chose to abandon work on SCNT because it was assumed that Hwang’s laboratory was so successful it would be better to collaborate than to independently develop the same technology. A sad as this outcome might be, it shouldn’t unduly worry us if it is rare. Based on the number of actual findings of research misconduct, Nicholas Steneck, Professor of History at the University of Michigan, Ann Arbor has estimated that the incidence of research misconduct is on the order of only 1 in 100,000 scientists per year. That said, this is merely a lower limit. We only definitively know about those cases that resulted in allegations, investigations, and publicly released findings. The actual number of cases is almost certainly higher, but it is debatable and probably not answerable whether that number is as high as 1 in 100, or in fact much lower.

The second way fraudulent science does damage concerns the realm of perceptions. Even if the incidence is as low as 1 in 100,000, false reports still undermine science. Widespread attention to cases of research misconduct dispropor- tionately harms the perception of science and of scientists. If the assumption that colleagues cannot be trusted taints scientific inquiry, it places collaborative science at risk. If the public fears that fraud is squandering resources, that places public support and funding of research at risk. Clearly, even if research misconduct is rare, the interests of science will be met in part by promoting ethics in research.

If the goal is to promote research ethics, then it is first necessary to be clear about its definition. Because they are typically adults, it can be expected that most scientists already know that it is wrong to lie, cheat, or steal. Specifically, it is wrong to make data up without bothering to do the experiment, it is wrong to change the results of an experiment so as to misrepresent what was actually found, and it is wrong to take credit for the words or ideas of someone else.

Specifically, it is wrong to make data up without bothering to do the experiment, it is wrong to change the results of an experiment so as to misrepresent what was actually found, and it is wrong to take credit for the words or ideas of someone else.

The practice of research is replete with determinations that in effect amount to ethical decisions. Unfortunately, most of the conclusions are not as straightforward as FFP. For example, what are the criteria for being an author on a paper? How long should research records be kept? What are the obligations of a mentor to her or his students? Under what circumstances should a prospective reviewer of a grant or manuscript decline to conduct the review because of a conflicting interest? Unlike FFP, these questions are not answered by precollege education or federal regulations. Instead, these dimensions of the practice of science are most likely to be learned in the context of doing research. This would ideally occur with training by the head of a research group or a thesis adviser. Although it can be one of the most effective means of socializing new scientists, strong evidence shows that this form of ethics training is infrequent, ad hoc, incomplete, and sometimes simply wrong. These concerns form part of the rationale for requiring that those supported by NIH training grants be given a formal opportunity to receive education in the responsible conduct of research (RCR).

The NIH requirement for RCR training has resulted in both good and bad news. The good news is that the mandate has garnered increased attention for this important part of the education of new scientists, led to the development of many new programs, and made resources for instruction in RCR widely available. The bad news is that most research trainees are not required to learn RCR because it has often been limited to those receiving support from NIH training grants. The NIH requirement’s exemptions include those who are ineligible for NIH funding, are in disciplines not supported by the NIH, or are not fortunate enough to be accepted for NIH funding. Although this is not the ideal solution for the scientific community,
Table 1. Topics for courses in research ethics.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
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<tbody>
<tr>
<td>Data Management</td>
<td>Planning, collection, record-keeping, ownership, sharing, and retention of data</td>
</tr>
<tr>
<td>Animal Subjects</td>
<td>Regulations and responsibilities for use of animal subjects</td>
</tr>
<tr>
<td>Human Subjects</td>
<td>Regulations and responsibilities for use of human subjects</td>
</tr>
<tr>
<td>Stem Cells</td>
<td>Regulations and responsibilities for stem cell research</td>
</tr>
<tr>
<td>Conflicts of Interest</td>
<td>Recognizing, avoiding or minimizing, and managing conflicts of interest</td>
</tr>
<tr>
<td>Publication</td>
<td>Factors in deciding what, where, and when research should be published</td>
</tr>
<tr>
<td>Biosecurity</td>
<td>Regulations and responsibilities for research that has the potential for misuse</td>
</tr>
<tr>
<td>Authorship</td>
<td>Criteria and guidelines for authorship</td>
</tr>
<tr>
<td>Peer Review</td>
<td>Roles and responsibilities of reviewers for career advancement, publications, and grants</td>
</tr>
<tr>
<td>Collaboration</td>
<td>Roles and responsibilities of research collaborators</td>
</tr>
<tr>
<td>Mentoring</td>
<td>Roles and responsibilities of mentors and trainees</td>
</tr>
<tr>
<td>Research Misconduct</td>
<td>Regulations and definitions of research misconduct</td>
</tr>
<tr>
<td>Whistleblowing</td>
<td>Roles and responsibilities for addressing perceived misconduct</td>
</tr>
<tr>
<td>Social Responsibility</td>
<td>Roles and responsibilities for scientists to use in communicating with the media, public, and policymakers</td>
</tr>
</tbody>
</table>

of course individuals are always free to seek out such training even if not required to do so.

Whether or not training is required, it is worth asking what topics might be covered in a course in RCR or research ethics. Lists of possible topics can be found in a variety of places, including the NIH requirement for RCR education10 and texts for research ethics courses. The lists vary, but certain topics are commonly considered to be important. The list in Table 1 covers more than any one course will typically include, but it should serve as a useful starting point for understanding the range of possible material. Not all of these topics will prove relevant to all researchers, but it should be clear that most apply to all research disciplines and that few are routinely covered in the context of informal mentoring in the research environment. To assess whether your own training is adequate, Table 2 lists several questions you can ask of yourself about each of these topics. Assuming you find you do need to know more, you might want to look into some of the resources this newsletter provides (please see the list of Resources for Ethics in Science on pages 4-5) and possibly enroll in a research ethics course at your institution.

In the past 15 years, numerous programs have promoted RCR training. To help prepare the instructors of such courses, Indiana University has developed a program in “Teaching Research Ethics” and the University of Pittsburgh offers an annual program in “Teaching Survival Skills and Ethics.” Nationally, the “Preparing Future Faculty” program has served as a resource to help nearly 300 institutions promote broad and effective graduate student training. More recently, the “Responsible Conduct of Research Education Consortium” was founded to identify, develop, and promote RCR education. These and other national resources are helping to increase the number and effectiveness of RCR programs.

Most of us chose a career in research because of the excitement and challenge of learning more about ourselves and the world in which we live. Because of the nature of research, our colleagues and society rely on us to conduct and report it responsibly. Although some mechanisms are in place to help us to learn about the responsible practice of research, this is not always the case. Whether or not such training is provided, our first responsibility is to seek out the necessary resources and information so that we can address the ethical dimensions of our role in research. We hope that this issue of the ACS Graduate Education Newsletter will provide a useful starting point.

Dr. Michael Kalichman is Director of the Research Ethics Program at the University of California, San Diego and a faculty member in the Department of Pathology, UCSD School of Medicine.

References
Resources for Ethics in Science
Compiled by M. Kalichman and M. Caserio, June 2006

Here is a reference list of resources that address both the ethical conduct of science and the teaching of ethics. It is a representative rather than an exhaustive summary of the many resources available and its content applies to a broader scientific field than chemistry alone.

Books

A n eminently readable book on professionalism and ethics in science with special reference to chemistry. A s the author states, the best way to learn ethical problem solving is through case studies, and he provides a comprehensive array of interesting cases of the type the chemist is most likely to encounter. There is also a useful list of references on ethics current to 2001. This book is available in paperback at nominal cost, and it is certainly on the "must have" list.

ORI Introduction to the Responsible Conduct of Research; Steneck, Nicolas H. Office of Research Integrity; DIANE Publishing Co: Darby, PA, 2004.

This useful text seeks to supplement existing resources by creating a comprehensive overview of basic rules of the road for responsible research available to all Public Health Service (PHS) funded researchers. It has been prepared with the needs of small and midsize research institutions and beginning researchers in mind, but it may prove useful in other settings. It is available online in pdf format at http://ori.dhhs.gov/documents/rcrintro.pdf but takes a while to download.


This booklet is available online at http://darwin.nap.edu/books/0309051967/html. Collective deliberation is the best procedure to apply in using this booklet. Group discussion can demonstrate how different individuals would react in specific situations, often leading to conclusions that no one would have arrived at individually.


These three texts are among the most widely used in courses on responsible conduct of research. Although they take slightly different approaches to the topic, each provides an outstanding basis for promoting awareness, understanding, and discussion.

Guidelines


International Committee of Medical Journal Editors.
CMJE: www.icmje.org

More than 500 biomedical journals subscribe to these guidelines, which are particularly useful for their focus on criteria for authorship.

Online Courses and Teaching Resources

Tutorials include: Conflicts of Interest, Mentoring, Responsible Authorship and Peer Review, Research Misconduct, Collaborative Science, Data Acquisition, and Management.

Responsible Conduct of Research Internet Instruction, sponsored by Responsible Conduct of Research Education Committee (RCREC): http://rcrec.org/r/index/php This is an online resource for RCR instructors. Online Modules on Responsible Conduct of Research, created by Center on Materials and Devices for Information Technology Research (CMDITR), with NSF support: www.responsibleresearch.org. These modules are described in the accompanying article by A. Ivan L. Kwiram, page 8. Currently they are accessible to qualifying institutions.

Online RCR Modules, Northern Illinois University: www.niu.edu/rcrportal

Responsible Conduct in Research Instruction, Eastern Michigan University: www.rcr.emich.edu

Teaching Research Ethics, Indiana University: http://poynter.indiana.edu/tre

Organizations and Websites
The Council of Graduate Schools, Responsible Conduct of Research Initiative. The Council of Graduate Schools has launched a major initiative designed to enhance the training of graduate students in the Responsible Conduct of Research (RCR). This initiative is made possible by funding from the Office of Research Integrity (ORI) and from the National Science Foundation (NSF). Information can be found by going to the Council’s homepage at www.cgsnet.org/ and entering “RCR” into the Search box.
American Association for the Advancement of Science. The AAS maintains a site that promotes informed discussion about and resources relevant to standards for ethical conduct (www.aaas.org/integrity). The site contains useful resource links, including a link to a set of videos that address integrity in scientific research (intellectual property, publishing, record-keeping, authorship, mentoring, stress, professional values, and reporting misconduct).

The National Science Foundation (NSF) has an ongoing program, Ethics Education in Science and Engineering, to improve ethics education in all fields of science and engineering: www.nsf.gov/pubs/2006/nsf06524/nsf06524.htm

Responsible Conduct of Research Education Committee (RCREC): http://rcrec.org

The mission of the RCREC is to provide leadership to the research community in identifying, developing, and promoting programs of education in the responsible conduct of research. The committee accomplishes its mission through collaborations among institutions, organizations, and federal agencies that have roles and interests in the responsible conduct of research. RCREC has now merged with the Association for Practical and Professional Ethics.

Sigma XI Program in Ethics: www.sigmaxi.org/programs/ethics/index.shtml

A Association for Practical and Professional Ethics (APPE): www.indiana.edu/~appe

Office of Research Integrity (ORI): http://ori.hhs.gov/

National Institutes of Health (NIH). Bioethics Resources on the Web: www.nih.gov/signs/bioethics/

President’s Council on Bioethics: http://bioethics.gov

Case Western Reserve. The Online Ethics Center for Engineering and Science: www.oeces.org/colloq/prasm.html

University of California, San Diego. Research Ethics Program: http://ethics.ucsd.edu

Duke University: www.gradschool.duke.edu/policies_and_forms/responsible_conduct_of_research/

Periodicals

Science and Engineering Ethics is a multidisciplinary quarterly journal, launched in 1995, exploring ethical issues confronting scientists and engineers: http://www.opragen.co.uk

A accountability in Research, published by the Taylor & Francis Group, contains original empirical, methodological, policy, and theoretical papers, case studies, conference reports, and book reviews that address issues of integrity and accountability in research: www.tandf.co.uk/journals/titles/08989621.asp

Hastings Center Report, promoting thoughtful, balanced reflection on the ethical and social issues of medicine and medical science: www.thehastingscenter.org. Please scroll down the homepage to find the Login button for the online version of the report.

American Journal of Bioethics targets articles that zero in on pressing problems in healthcare or biomedical science, followed by Open Peer Commentary articles written about each target article by scholars in many disciplines: www.bioethics.net/journal

Miscellaneous Reports and Articles


Fostering Integrity in Research: Definitions, Current Knowledge, and Future Direction; Steneck, Nicholas H. Science and Engineering Ethics 2006, 12, 53–74. www.opragen.co.uk/SEE/abstract.php3?id=660


A Pressure Cooker for Postdocs? Benderly, Beryl. ScienceCareers.org website, July 2006, can be read at: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/2006_07_07/a_pressure_cooker_for_postdocs
Editor’s Column—ACS and Ethics

Marjorie C. Caserio, University of California, San Diego

A quick scan of the contents of this issue of the newsletter will reveal that it concerns professional ethics. Trust in the ethical conduct of our peers is fundamental to a healthy scientific community sharing its results and achievements and building on one another’s discoveries. Sometimes this trust is violated, and while misconduct in science is not a new problem, it appears to be an increasingly serious one. We are faced with questions of why, and whether greater efforts should be made to ensure that ethical standards are upheld in the conduct of research. The American Chemical Society, as the largest scientific professional society, should have something to say about ethical practices, and indeed it does. However, the complex structure of the organization makes it difficult to cover all constituencies with one set of guidelines. Instead, various statements have evolved according to particular professional objectives (education, publication, employment).

The Committee on Professional Training (CPT) recently responded to the inattention to ethics instruction in the nation’s colleges and universities by issuing supplemental Guidelines for the Teaching of Professional Ethics, which call for ethics training in the undergraduate curriculum (http://www.chemistry.org/portal/a/c/s1/acsdisplay.html?DOC=education\cpt\ts_ethics.html). The guidelines give reasons why undergraduates should have ethics training, what topics should be addressed, alternative strategies for instruction, and relevant source materials. There are, however, no comparable ACS guidelines for ethics training at the graduate level where, arguably, the need is greatest. This is probably an artifact of CPT’s long-standing practice to leave standards in graduate education to the graduate schools. Likewise, the ACS Aademic Professional Guidelines (see below) offer well-meaning behavioral ideals for students and postdocs but balk at calling for ethics training in graduate school. Most of the pressure on schools to provide training in the responsible conduct of research has come from federal funding agencies (NIH and NSF).

Publication and employment ethics have fared better than graduate education ethics, although the situation is complicated. Ethical standards in the publication of chemical research are crucial for the credibility of the discipline and the journals. A CS has long recognized this, and strives to ensure that its guidelines are well served by editors, authors, and reviewers. Revisions to the guidelines are made periodically, and the most recent version dates to 2000 (see the accompanying article by Eric Slater on page 10 or Ethical Guidelines to the Publication of Chemical Research. Chem. Rev. 2001, 101, 13A–15A). Integrity in scientific publishing is an area of intense interest for all the reasons evident in Slater’s article. Publishing integrity is further complicated by an increasing pressure from scientists for rapid and less expensive communication by electronic means, which diminish the checks and balances of peer and editorial review. Even the traditional peer review system cannot easily detect plagiarism, falsified data, fragmentary and duplicate publications, and coauthorship problems (see C & EN, April 10, 2006, 85 (15), 62–66).

Regarding professional ethics, the Council Committee on Professional Relations was the Society’s conscience on ethics for many years and is responsible for the much-cited ACS guideline on The Chemist’s Code of Conduct, which is a concise set of statements of the professional obligations expected of chemists to the public, to colleagues, and to science. It appears in the webpages of the ACS Department of Career Management and Development, formerly the Department of Career Services (www.chemistry.org/portal/a/c/s1/career.html?DOC=careers%5cpub02.html). This is not the only confusing name change that has occurred. Some years ago the Committee on Professional Relations became the Committee on Economic and Professional Affairs (CEPA), and the task of formulating ethical guidelines fell to CEPA’s Subcommittee on Standards and Ethics. Besides revisions to the Code of Conduct, the subcommittee has produced other relevant CEPA publications including brochures on Academic Professional Guidelines, Professional Employment Guidelines, and Plagiarism: Intellectual Property Rights. Very recently, the subcommittee (now called CEPA’s Task Force on Standards and Ethics) has revised and renamed the Chemist’s Code of Conduct as the Chemical Professional’s Code of Conduct. The revision is currently under review and will be presented for consideration at the ACS Board of Directors during the fall ACS national meeting in San Francisco, 2006. The task force is also undertaking a revision of the Academic Professional Guidelines.

From the foregoing, it would appear that some level of coordination or centralization of activity in the area of ethics within ACS could be helpful. In fact, a most recent development is the creation of a new ACS Committee on Ethics, which could well be helpful in providing leadership, visibility, and coordination. The first meeting was held in March 2006 at the Atlanta ACS meeting. The Committee Chair, Margaret Cavannaugh of NSF, reported that apart from reviewing its charge, the committee agreed on two areas to pursue in the near term: Ethics Education, and Ethics Awareness. Just how this committee will actually function remains to be seen, but there certainly seems to be much that it could do.

Dr. Marjorie Caserio is a consultant to the ACS Office of Graduate Education and Editor of the Graduate Education Newsletter.
In the late 1990s, the Office of Research Integrity (ORI), a government office in the Department of Health and Human Services (HHS), established a small research program to study research integrity. ORI has dual responsibilities for overseeing research misconduct investigations and promoting efforts to foster integrity in Public Health Service (PHS) funded research. To carry out its mission more effectively, ORI felt that it needed more information about research behavior. With a modest increase in budget authorization and administrative assistance from the National Institute of Neurological Disorders and Stroke (NINDS) in the National Institutes of Health (NIH), the joint ORI/NIH Research on Research Integrity (RRI) Program was launched in the spring of 2000. To date, the RRI Program has awarded a total of more than $12 million to 31 researchers, who have presented their findings at the biennial ORI research conferences and in more than 30 publications.

At the time the RRI program began, most observers would have summarized their views on integrity in research roughly as follows: First, there was, and still is today, widespread agreement that the standards for integrity in research should be set very high. Second, although it is clear that all researchers do not live up to these standards, those who fall far short of the mark are believed to be few in number and quickly discovered through the normal replication and professional self-regulation that is an inherent part of research. Third, apart from serious misconduct, which is usually defined as “fabrication, falsification, and plagiarism” (FFP), it was and still is assumed that most researchers do in fact generally follow the rules and commonly accepted practices that define the responsible conduct of research.

Unfortunately, the growing body of research on research integrity, funded in part by the ORI/NIH RRI program, is now making it clear that this commonly accepted view of integrity in research has some serious shortcomings. Most obvious is the increased realization that serious misconduct is not as rare as it was once assumed to be. A part from the continual appearance of new cases, empirical evidence—some based on self-reporting—suggests that as many as 1 in every 100 researchers may engage in practices their colleagues consider serious violations of the standards for the responsible conduct of research. Research misconduct may not be common, but it is also not as rare as many in the past have suggested and some still believe today.

A second commonly embraced misperception about research integrity is the view that researchers do a good job of monitoring their own behavior through replication and peer review. Many experiments are never repeated, due in part to the fact that researchers are rewarded for making new discoveries, not for replicating work already done. A number of major cases of misconduct have slipped through the routine checking that is supposed to take place within research groups and through outside peer review, leaving the detective work to everyday journal readers or, more recently, unofficial email networks and blogs. There is as well the inherent conflict between the professional responsibility to report suspected misconduct and misplaced loyalty to long-time colleagues and friends. In combination, these factors significantly compromise the ability of researchers to monitor their own behavior.

The third and most significant misperception about integrity in research is the assumption that research misconduct is the most important integrity issue researchers and policymakers face today. It is true that most researchers do not engage in the most serious research misbehaviors (FFP), but many do engage in what a 1992 National Academy of Sciences report called “questionable research practices.” In numbers ranging upward from 1 in 10 (10%), researchers commonly bend and break seemingly small and unimportant rules, such as accepting or claiming authorship, or both, when they have not made significant contributions to publications; failing to report all findings and not just those that support their hypotheses; or failing to give credit to colleagues when they use their work or ideas.

Questionable research practices deserve attention because they can erode confidence in the integrity of the research process, violate traditions associated with science, affect scientific conclusions, waste time and resources, and weaken the education of new scientists. A failure to conduct a proper literature search or to report all findings can result in harm to research subjects or public health. A practice called “salami publication”—chopping research into multiple publications to increase apparent productivity—wastes reviewer and reader time as well as publication funds and can seriously distort the interpretation of clinical trials. Deceptive research designs and biased statistical analyses improperly skew results and the policy decisions based on them. It has been suggested that hundreds of millions of dollars are spent each year on drugs and treatments that are neither effective nor less expensive than elsewhere, and that many are based on them. It has been suggested that hundreds of millions of dollars are spent each year on drugs and treatments that are either not effective or no better than less expensive drugs and treatments, due in large measure to questionable design and interpretation practices. Waste and the harm caused at this level far exceed the impact of deliberate research misconduct.

These and other shortcomings could be reduced considerably if more researchers made more of an effort to set truly high standards for integrity in research. In practical terms, this requires first knowing and then following the basic rules, regulations, and commonly accepted practices. Government and research professionals agree that essential rules for research integrity are:

1. Data management—The rules and practices that define how data should be recorded; stored; interpreted; reported; and analyzed.
2. Design—the essential components of a research process that will produce valid, useful information.
3. Design—the rules and practices that define how data should be recorded; stored; interpreted; report.
write this brief summary of online training options for Responsible Conduct of Research while resident at Wolfson College, Oxford University. The significance of this venue is that the President of Wolfson College, Sir Gareth Roberts, has been instrumental in stimulating a major initiative in the United Kingdom to provide “transferable skills training”—or what we might refer to in the United States as professional training—to graduate students in U.K. universities. These training programs, which amount to about 20 hours cumulative per year for three years, are specifically funded by the United Kingdom Research Councils and include a variety of topics such as, “Introduction to Ethics,” “Success in the Ph.D. and Beyond,” “Networking and Teamworking,” “Your IP [intellectual property] and its Protection,” “Personal Effectiveness,” “e-Tools,” and other more discipline-specific topics. This has now for little if they are not put into practice, and it is current practice that probably poses the greatest challenge for integrity in research today. For a variety of reasons that are not as yet fully understood, many researchers engage in practices that are at odds with responsible research practices; a smaller but significant number venture into the territory of more serious misconduct. The normal pressures of doing research probably have a great deal to do with this. Rules can be ignored if they are seen as too burdensome or unfair. Publication pressures can lead to lowering standards for authorship. Funding pressures can lead to reporting results before they are fully confirmed or to withholding results that might lessen the chances of getting future funding. There are, unfortunately, more than enough seemingly “good” reasons to justify most bad decisions. The measure of the ability of researchers to avoid the temptation of excuses and to live by professional standards and best practices, in the end, is the best measure of research integrity.

References
1. A didtional information about the ORI/NIH RRI Program can be found at the Office of Research Integrity website: http://ori.hhs.gov/research/extra/index.shtml

Dr. Mary D. Scheetz is Director, Extramural Research, U.S. Office of Public Health and Science, Office of Research Integrity, Department of Health and Human Services, Washington, DC.

Dr. Nicholas H. Steneck is Professor of History at the University of Michigan, Ann Arbor, and Consultant to the Office of Research Integrity, Department of Health and Human Services.
learn how to communicate more effectively, both orally and in written form. These are all positive developments. Here I would like to briefly describe another program developed at the University of Washington (UW) to provide researchers with some basic information about “Responsible Conduct of Research” (RCR).

This program grew out of a need to provide a foundation for various areas of RCR for all participants (some 250 students, postdocs, and faculty) in a National Science and Technology Center funded by NSF and headquartered at the University of Washington. The approach taken was to develop a set of three one-hour online modules which any participant can access and take at any time. All participants in the C enter including faculty and staff are required to take the modules and be certified. The three interactive modules include the following elements.

**Module 1: Rights and Obligations.**
1.0 Introduction, 1.1 Responsibilities of Science and Technology Center (STC) participants, 1.2 Research misconduct, 1.3 Error and negligence, 1.4 Conflict of interest, 1.5 Stewardship of data.

**Module 2: Collaboration, Communication, and Grants Management.**
2.0 Introduction, 2.1 Diverse workplace, 2.2 Publication and openness, 2.3 Allocation of credit, 2.4 Authorship practices, 2.5 Grant management.

**Module 3: Intellectual Property.**
3.0 Introduction, 3.1 Rationale for protecting IP, 3.2 Types of IP protection, 3.3 Lab procedures and conduct, 3.4 Interactions outside your institution, 3.5 Questions and disputes.

It typically takes 2–3 hours to complete the modules. Participants must answer a series of questions correctly before they can be certified. The program has been surprisingly well received, and when it was described at a meeting of all the Directors of the NSF STCs, they asked that it be made more widely available to other STCs. That has now been done. Indeed, the material has now been further revised (to address copyright issues) so that it is now available online to any academic institution. A ny program or department that would like to use the modules has to go through a simple registration procedure in order to allow access for the participants at that site in the corresponding program or department. The instructions for registering can be found at www.responsibleresearch.org. Alternatively, the registration menu can also be accessed by starting at the C enter website at http://stc-mditr.org/ and following the links to “Education” and then “Education Programs” and finally, “RCR Tutorials.” Once a site is registered, students can be certified.

This set of modules is not intended to satisfy fully the need in these and related areas of professional training. However, it is felt that institutions have a responsibility to go beyond simply mentoring students in research; we need to educate them about what it means to be a practicing scientist who behaves with integrity and sensitivity. The RCR modules represent a first step that not only provides a baseline of common understanding, but also opens a series of sometimes delicate issues for discussion, issues that otherwise might be ignored only to erupt at some unexpected moment with unpleasant consequences. Disputes about authorship or intellectual property are two common examples.

At our Center (The Center on Materials and Devices for Information Technology Research or CMDITR), we supplement the online modules with face-to-face seminars in which a speaker with expertise in some area makes an introductory presentation (20 minutes typically) and outlines a case study and poses some challenging questions. The audience is then divided into groups of about 8–10 individuals, where each group discusses the issues and decides on a solution. These decisions are then shared with the entire group, and further discussion ensues, moderated by the speaker, who concludes the session with some summary observations. These sessions are broadcast live (and recorded for archival purposes) to some of our partner institutions such as Georgia Tech and the University of Arizona, where participants can engage in real-time with the live seminar at the UW. Likewise, similar sessions at those institutions are shared with the other partners. These archived seminars can also be made available.

For example, a recent session focused on RFID (Radio Frequency Identification) tags and the ethical issues raised by the “invasion of privacy” problems that ubiquitous tracking would create. A nother session involved a presentation by a seasoned journal editor who discussed his experiences over the years with authorship and publication disputes including practices involving the order in which authors are listed on a publication. Many of us take such practices for granted—until a problem arises. Then it is often much more difficult to resolve the matter than it would have been had it been addressed early in the process.

Institutions of higher education have historically assumed that once students enter a doctoral program they have a fully formed understanding of ethical principles, of interpersonal dynamics, of cultural sensitivities, and of other similar topics. A ll that is left, it is assumed, is to develop their intellectual powers in research and then they will be ready to serve as leaders for the next generation. This model was never valid, and today is even less tenable. In an increasingly complex world with growing scrutiny of science and scholarship (in part because of the increasingly important roles they play in commerce and politics), it is imperative that we teach not only skills in research, but also the leadership and professional skills that will make our graduates more effective leaders within the scientific enterprise and in civic discourse.

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Dr. Alvin L. Kwiram is Professor of Chemistry and former Vice Provost, University of Washington, Seattle. He is also the Chair of the ACS Graduate Education Advisory Board.
Publications, Plagiarism, Copyright, Legal, and Ethical Issues

Eric S. Slater, Esq., Manager, Copyright, ACS Publications Division

Like most scholarly journal publishers, the American Chemical Society takes very seriously ethical issues related to its publishing operation. The ACS expects its authors to abide by specific printed guidelines, entitled “Ethical Guidelines to Publication of Chemical Research.” These are found on the ACS Publications website: https://paragon.acs.org/paragon/ShowDocServlet?contentId=paragon/menu_content/newtothissite/eg_ethic2000.pdf. A section of the guidelines specifically addresses the author’s ethical obligations, and although this article does not focus on these ethical guidelines per se, it will discuss several of them. It will also address other important issues that pertain to copyright and plagiarism—where there are certainly ethical concerns, and in the case of copyright, legal ramifications. This article’s purpose is to provide the reader with an overview of publication, plagiarism, copyright, legal, and ethical issues. Its intention is to bring about greater understanding so as to aid authors in avoiding the pitfalls inherent in these areas.

ACS Ethical Guidelines—Highlights

For full details, please refer to the URL given above. Some highlights include:

- A authors are obligated to present an accurate account of the research performed as well as an objective discussion of its significance. There have been situations where authors have detailed experimental procedures resulting in uncertain outcomes, and later attempts at reproducing the results have been unsuccessful. If this is intentional in order to get published, that certainly ranks as egregious; if not intentional, authors have a duty to make certain they are publishing accurately, and this duty extends to retracting articles if necessary.
- A authors are required to cite those publications that have been influential in determining the nature of the research reported, and also to accurately and appropriately identify the sources of all information quoted or offered. It is here where the issues of plagiarism and copyright appear; I will delve more deeply into these areas below. Essentially, there is a protocol to follow; it includes obtaining permission from copyright owners when repurposing content not original to the author and also giving credit to the original author when “borrowing” from already published material.
- It is understood that manuscript submission to an ACS publication is exclusive to that publication. Authors cannot submit the identical manuscript to multiple publications, whether to multiple ACS publications or across journals published by different publishers. This “scattershot” approach is a severe ethical breach, which can also have legal implications from a copyright standpoint. When authors do this, the end result could be different publishers publishing the same paper, all without the knowledge that any of them are doing so. A authors in this situation are typically transferring the copyright to multiple publishers, which leads to uncomfortable—not to mention awkward—situations among publishers when they learn what happened. The first to publish can claim copyright, leaving the other publishers that subsequently published the same paper to have to “clean up” the mess. Publishers in this predicament must remove or retract the papers from the Internet and publish errata in a future issue of the print version.
- A authors are required to be truthful about this, and to disclose all contributions should be indicated in a footnote or “Acknowledgments” section. It is the responsibility of co-authors to be truthful about this, and to keep ethical considerations in mind when deciding to include or exclude individuals as co-authors. A CS guidelines stipulate “the co-authors of a paper should be all those persons who have made significant scientific contributions to the work reported and who share responsibility and accountability for the results.” There are times when this is in dispute, when it may or may not always be appropriate to include individuals as co-authors. A CS guidelines here instruct, “other contributions should be indicated in a footnote or ‘A cknowledgments’ section.” It is the responsibility of co-authors to be truthful about this, and to keep ethical considerations in mind when deciding to include or exclude individuals as co-authors. In such disputes, A CS will generally not publish these articles until the parties resolve the issue. Related issues also include requests to remove names after manuscripts have been submitted and accepted. A authors need to bear in mind that the publisher is at risk legally if it removes the name of someone and that person subsequently files a lawsuit. A through a lawsuit in this scenario might include multiple defendants (co-authors, the employer, and the publisher), the publisher is usually the party with the “deep pockets,” and as such, potentially has more to lose.

Copyright Infringement and Plagiarism

These are complicated issues to say the least, and I will deal with each separately. For the sake of simplicity, it is instructive to deal with copyright infringement as a legal issue and plagiarism as an ethics issue. There may or may not be overlap between the two; copyright infringement and plagiarism are not necessarily the same thing, and they can—and generally do—exist separately. One legal definition of plagiarism states “the offense of plagiarism is known in the law as infringement of copyright.” (Barron’s Law Dictionary,
Copyright infringement (not intended as legal advice) Under United States Copyright Law, copyright is defined as "a form of protection provided by the laws of the United States (title 17, United States Code) to the authors of 'original works of authorship,' including literary, dramatic, musical, artistic, and certain other intellectual works." (www.copyright.gov/circs/circ1.html#wci) Copyright extends to a wide array of works (Subject Matter of Copyright, Section 102, Title 17), including, but not limited to literary works, artistic works, musical works, etc. The owner of a copyright is automatically granted a certain "bundle of rights" (Exclusive Rights of Copyright, Section 106, Title 17), including, but not limited to making copies of the work, distributing the work, displaying the work, etc. See www.copyright.gov/ for full descriptions of these sections.

Copyright infringement is the unauthorized use of copyrighted material in which one or more of the exclusive rights are violated. Common forms of infringement of ACS Publications Division content include the unauthorized copying and distribution of journal articles and the displaying of articles on public Internet websites, as well as the use of other content (primarily figures, tables, etc., without obtaining permission). In contrast to plagiarism, the user is not necessarily intending to pass the copy of the original works off as his or her own.

The best way to avoid copyright infringement is to obtain permission from the copyright owner (whether an individual or publisher) to repurpose content. The view of the ACS Copyright Office is that it never hurts to ask for permission, and permission should always be sought whenever one is in doubt as to whether he or she can repurpose particular content. The majority of publishers in the scientific, medical, and technical (STM) areas of publishing all provide permissions guidelines, or some similar materials, on their websites. This helps to simplify the permissions process, especially for novices, and provides valuable assistance in the quest to educate researchers about copyright.

The penalties for copyright infringement can be severe. Many cases are resolved without litigation, typically resulting in cease and desist letters, and ultimately, removal of the offending content. Perhaps a licensing fee is negotiated for prior, unauthorized use, and forward authorized use. In litigation resulting in lawsuits, courts have the authority to impose penalties in the form of fines. Fines can range from $750 to $30,000 for each incidence of infringement. Amounts are up to the discretion of the courts, and incidences of willful infringement carry larger penalties.

Plagiarism
Plagiarism is defined as the passing off of another person's work as one's own. It can be argued that in instances of plagiarism, the individual who is plagiarizing is doing so intentionally. Of course, this is not true 100% of the time, but nevertheless, plagiarism carries some quite serious ethical ramifications. Students can be expelled from school; professionals can be terminated from their jobs for committing plagiarism. The Oxford English Dictionary defines it as "the wrongful appropriation or purloining, and publication as one's own, of the ideas, or expression of the ideas... of another." Suggested sources for further in-depth reading include an article entitled "What Is Plagiarism?" in the December 17, 2004 issue of the Chronicle of Higher Education, and for those so inclined, an excellent law review article, "Copy Wrong: Plagiarism, Process, Property, and the Law," by Laurie Stearns, 80 Calif. L. Rev. 513, 1992.

The Chronicle article states that the outright copying of someone else's writing is only the most clear-cut form of plagiarism. It may be copyright infringement as well. What is not so clear-cut are instances of writers subconsciously "borrowing" so to speak, from material they may have read in the past. A recent example would be the case of Kaavya Viswanathan, the Harvard student who allegedly plagiarized material from several other authors in her novel, How 0 pal M ehta G ot Ki ssed, G ot W ild, and G ot a Life. The book was pulled by the publisher, who will not publish a second book under contract. A well-known case involving so-called "subconscious plagiarism" is the 1970s lawsuit involving George Harrison and the similarity between his hit song "My Sweet Lord" and the Chiffon's 1963 hit "He's So Fine." Poor George lost that case to the tune of (no pun intended) a half million or so dollars.

In the A CS Copyright Office, typically we view anything in the plagiarism realm as copyright infringement, taking the forms described above. Also, we are seeing more instances of "self-plagiarism" being committed by authors. I alluded to this in the earlier section addressing the A CS Ethical Guidelines; this is the situation where authors submit identical manuscripts to multiple journals in the hope of one journal publishing it. A nother scenario is when authors borrow quite liberally from previously published papers and attempt to pass it off as new research. This usually will occur with a marked lack of citation to the previously published work(s).

Conclusion
Quite simply: Follow publishers' ethical and copyright guidelines (most STM publishers have them), seek permission when repurposing copyrighted material (just about everything from 1923 forward is protected under copyright, except for U.S. Government works), and make certain to give appropriate citation to all sources.

Eric S. Slater is Manager in the ACS Copyright, Publications Division.

4th ed.). Suffice it to say that the two can exist with and without the other. I strongly urge readers to research these topics further for greater understanding.
Student Responses to Ethical Situations
Marjorie C. Caserio, University of California, San Diego

While instances of flagrant scientific misconduct are documented, rarely do chemistry graduate students or postdocs report egregious examples of misconduct during the course of their graduate studies. They are likely, however, to hear of or experience situations where they will have to advise or make decisions based on their ethical and moral values. How or where do they acquire such values? The teaching of ethics, particularly scientific ethics in the physical sciences, is seldom an institutionalized part of the graduate curriculum. It is implicitly understood in most chemistry graduate programs that the responsibility of the research advisor is to prepare the students to do high-quality research and maintain high standards of integrity, both in research and toward society. Whether this advisory responsibility needs to be supplemented can be debated.

To get a sense, however anecdotal, of students’ values and their reactions to problems in research ethics, we invited a number of chemistry graduate students from different schools to respond individually to a set of four questions. Each one deals with problems the students or their peers might possibly encounter in their graduate work. We wish to thank the students for their cooperation and willingness to express their opinions about the issues raised, and we are pleased to provide a summary of their responses. Out of respect for the students involved, their identities are not given in full.

Research Misconduct: Whistle Blowing QUESTION: A fellow graduate student has told you that she believes her thesis adviser has fabricated some of the data that will be included in the paper she is writing. She is unwilling to give you more details, but asks for your advice about what she should do. What would be your advice?

- This is a very serious problem as it can damage the reputation of all parties involved, including the academic institution. She should first discuss the issue with her thesis adviser, as it may be a simple misunderstanding. If her adviser is still adamant about using fabricated data, she should talk to the department chair. If there exists an ombudsman in the graduate program, she should consult with that person. — bdm

- She should first look into the situation further and find out more information about the data in question. If she still believes the data has been fabricated, she should first discuss it with her adviser. If that doesn’t work, the next step would be to go to the department head and present the evidence she has. This is a scary thing for a graduate student to do, because she risks alienating her adviser and creating a poor working environment for herself, but the consequences of publishing false data would be far worse. — anon.

- For myself, depending on my relationship with my adviser and how confident I was that the data was fabricated, I would ask my adviser to remove my name from the paper, or I would go to the chair. Having my name on a falsified paper would grate on me forever. — ml

- She should first write down what data she believes is questionable and why. If, after talking with her adviser, her concerns are not addressed satisfactorily, it will be easier to take them to the graduate division, department advisers, a trusted professor, or the appropriate ombudsman. — ys

- If the adviser indeed decided to fabricate some of the data, the student must confront the adviser. — da

- I would advise her to remove her name from the paper if she does not feel comfortable with the results that will be published. Also, she should talk to another member of her committee for further advice. — anon.

- It is absolutely unacceptable to fabricate data in the scientific community. Not only is it intrinsically wrong, but also could act as a hindrance in the advancement of science. The student should find a respectful way of discussing this subject with her thesis adviser. — anon.

- This is a tough one. Handled incorrectly, this student will hate the rest of her career as a graduate student. I suppose the only route available is to talk to the chair of the department and pray for discreetness. — anon.

Authorship QUESTION: You are first author on a paper that you are just getting ready to submit for review. The head of your research group tells you that you should add the name of a postdoctoral researcher who is just going on the job market and needs more publications. The postdoctoral researcher has not made any contributions to the research project. Would it be wrong to add his name?

- It would absolutely be wrong to add his name to the paper. If the postdoc hasn’t made any contributions, he shouldn’t receive any credit. — anon.

- Absolutely, and if the postdoc has any integrity, he wouldn’t accept the offer. — ml

- Unfortunately, this happens all the time in academics and also in the business world. It is definitely wrong and should not happen, but it does. In the long run, the postdoctoral researcher is the one that is hurt as he or she has her name on a paper on research with which they aren’t completely familiar. — bdm

- Yes, it would be wrong. Otherwise, there is the problem of misrepresentation and accountability of the postdoc’s experience to fellow scientists. If there is something the postdoc could contribute to the project, I would suggest to the PI that it be done. — ys

- For myself, I might not openly object, but since the postdoc does not meet our university’s requirements for authorship, I would not want to see his name included. But I would probably leave the final decision to our adviser. — anon.

- Being listed as an author of a paper implies a large involvement in the research and/or writing of the paper. If the postdoc has made no contribution,
it would be wrong to add his name to the paper simply to improve his CV. Although this may seem an innocuous matter, it would devalue the work put into the project and paper by the other parties. — anon.

- Needing more publications is not adequate to justify authorship. — anon.

**Mentoring**

**QUESTION:** You are in the fifth year of your graduate program and hope to complete your thesis in less than a year. Unfortunately, you have not begun to look into job opportunities and you’ve never received any advice from your thesis adviser, nor has she ever made any attempts to introduce you to other research groups in your field. What should you do now?

- If your adviser can’t (or won’t) help you begin the search for a job after first asking, you should find a mentor who will. Most schools have staff that can assist graduate students with job searches and provide career advice—you should look into these resources as well. — anon.

- I guess technically your thesis adviser’s only role involves your thesis and graduation—and not necessarily anything beyond that. But that does not mean he/she can’t or shouldn’t help you or that you shouldn’t approach him/her for assistance. Also, try to form your own contacts. Go to every event or gathering you can and make yourself known. — ml

- The working world doesn’t come knocking on most students’ doors. I would definitely be proactive and initiate the job search. Bring the topic up with the thesis adviser. Perhaps she was just waiting for you to be ready to bring it up with her. Most schools have programs that help students prepare résumés, look for jobs, and practice interviewing skills. — bdm

- I would start being more active in asking my adviser for suggestions as well as considering short-term postdoctoral positions until a position is offered. I would also ask other faculty, postdocs, students, and others for advice, information, and suggestions. I would visit career centers and graduate offices, look at scientific advertisements in academia and industry, and make sure my name is on mailing lists in which positions and fellowships are announced. I would start networking at conferences and talking with visiting speakers so they know of my interests, keeping an updated CV, research statement, and website on hand.— ys

- I would make an initial attempt to see if my research adviser was willing to offer advice. If she appeared unwilling to help, I would start looking on the Internet for jobs, and talking to other classmates that had received better mentoring throughout their graduate work. If there were another faculty member whose opinion I valued, I would approach him/her for advice. — anon.

- It seems as if this problem could be remedied by talking to your thesis adviser. If no help is forthcoming, then it may be time to take the matter into your own hands. — anon.

- Everyone should have a five-year plan at all times. With one year or less to go, it is time to take things into your own hands. First, bring it up with your thesis adviser and let him/her know the direction you would like to pursue. This will immediately let you know how much help to expect. Without help, it will be difficult to make contacts, but contacts are key, so starting with other groups in your department and at ACS meetings may be fruitful. Also, start searching postdoc listings and job listings. — anon.

**Social Responsibility**

**QUESTION:** Your state legislature is debating the possibility of increased monitoring and regulation of the levels of an environmental toxin. Based on your expertise, you know that the technology is not available to make the measurements needed. A newspaper reporter has called to get your perspective on this legislation. Do you accept the request for an interview, however, I would do more research on the subject so that, when asked, my answers/solutions are well informed and feasible. — ys

- In this situation, politicians have no expertise to make a decision. I would definitely accept the request for an interview, for it is my responsibility to apply the knowledge politicians lack to contribute to the improvement of the social situation. — da

- I would accept the interview, though I would request not to be named in the article. I think it is important that the public be informed about current scientific affairs. — anon.

We also asked the students to comment on which ethical issues involving graduate students and postdocs they feel could be better addressed by advisers, universities, or both. Here are the comments we received.

- Fabricating data is a fairly prevalent problem, and it can start very small. The pressure to make data “tell you” something that it isn’t makes it easy to take it one step further and make up data to fit the story that you want to tell. I’ve seen this happen on a number of occasions in my professional career. Usually the person isn’t a bad person, just someone that is under pressure to perform. From a management perspective, the key to the working environment is the science, not the number of publications. — bdm

Continued on page 14
There should be more coverage on what types of research, to what extent, and where research can legally be done (e.g., areas such as stem cell research and research funded by the different federal agencies). This awareness would be particularly useful when working with people from different countries. — ys

Knowing how to deal with politicians, regulatory agencies, and universities regarding potential research could also be looked at. — ys

Another problem is that of students knowing what their rights and responsibilities are and how to get a quick response to problems they come across. — ys

These situations actually seemed to well represent the ethical problems that a graduate student could realistically expect to encounter. — anon.

Conclusions

The students have clearly given serious thought to the ethical problems raised and have provided answers that reflect their own strong regard for ethical standards. Even though the limited set of responses precludes drawing firm conclusions, a few valid observations can be made. The comments are reassuring on one level, but they suggest that the situations posed in the questions are not uncommon. This is troubling. Do graduate students witness more instances of scientific misconduct than previously thought?

A nother observation relates to the student's reliance on the research adviser, indicating that the student-adviser relationship transcends that between the student and any other individual or group. Yet this reliance apparently does not extend to the job search, given that most responses seemed to fault the student more than the mentor for inaction.

There is, moreover, an element of apprehension that emerges from the collective response—a sense that approaching the adviser or the department chair poses some risk because it might jeopardize the student's own graduate standing. This raises some serious questions. Can we expect students to report ethical misconduct in light of possible or perceived retribution from advisers, peers, or chairs? To what extent do students ignore unethical research practices because of loyalty to their research advisers and fellow students? If students are reluctant to report problems to their advisers or the chair of the department, for whatever reason, where can they turn if they encounter an unethical situation? We need to hear more from students about their experiences and the conflicts they face. We need also to hear from departments as to how they resolve such conflicts.

Comments on these and other ethical issues are welcomed and should be addressed to GradEd@ACS.org.

Dr. Marjorie Caserio is a Consultant to the ACS Office of Graduate Education.

The comments are reassuring on one level, but they suggest that the situations posed in the questions are not uncommon. This is troubling. Do graduate students witness more instances of scientific misconduct than previously thought?
This list of events has been compiled by the ACS Office of Graduate Education. For additional information, please contact us at GradEd@acs.org or visit our website at chemistry.org/education/student/gradeducation.html.

**SUNDAY, SEPTEMBER 10**
9:00 am–1:15 pm  
Moscone Convention Center  
Room 228/230  
**Careers for Computational Chemists in Pharma, Biotech, Patent Law, Software Vendors, and the National Institutes of Health**  
Sponsored by the Division of Computers in Chemistry, the Division of Chemical Information, and the Division of Professional Relations

1:30 pm–4:30 pm  
Marriott—Pacific Room I  
**Chemistry of Wine**  
Sponsored by the Younger Chemists Committee, the Division of Small Chemical Businesses, and the Division of Analytical Chemistry

**MONDAY, SEPTEMBER 11**
8:30 am–11:55 am  
Marriott—Pacific Room I  
**The ACS Throughout My Career**  
Sponsored by the Younger Chemists Committee, the Division of Professional Relations, and the Women Chemists Committee

8:30 am–11:55 am, 1:30 pm–4:35 pm  
Marriott—Pacific Room F  
**ChemCensus 2005: The Present and Future of Chemistry**  
Sponsored by the Division of Professional Relations, the Society Committee on Education, the Division of Chemical Education, the Committee on Economic and Professional Affairs, and the Division of Professional Relations

9:00 am–11:20 am  
Marriott—Pacific Room A  
**Women Chemical Entrepreneurs**  
Sponsored by the Women Chemists Committee, the Division of Professional Relations, the Division of Small Chemical Businesses, and the Younger Chemists Committee

9:00 am–11:30 am  
Marriott—Pacific Room J  
**Leadership in Scientific and Technical Organizations: A Critical Skill for Advancement and Success**  
Sponsored by the Division of Professional Relations

1:30 pm–4:00 pm  
Marriott—Pacific Room I  
**Strategies for Being a Successful Ph.D. Student**  
Sponsored by the Younger Chemists Committee, the Division of Small Chemical Businesses, and the Women Chemists Committee

8:00 pm–10:00 pm  
Moscone Convention Center—Hall D  
**Academic Employment Initiative—SciMix**  
Sponsored by the Division of Chemical Education, the Committee on Corporation Associates, the Division of Professional Relations, the Committee on Science, the Division of Business Development & Management, the Committee on Economic & Professional Affairs, the Committee on Minority Affairs, the Society Committee on Education, the Women Chemists Committee, the Division of Professional Relations, and the Committee on Professional Training

**TUESDAY, SEPTEMBER 12**
8:00 am–11:45 am, 1:00 pm–4:30 pm  
Marriott Courtyard—Soma 2/3  
**Equipping the 2015 Chemical Technology Workforce**  
Sponsored by the Division of Chemical Technicians, the Committee on Technician Affairs (CTA), ChemTechLinks, CEN-ChemJobs, the Committee on Corporation Associates, the Division of Chemical Education, the Division of Professional Relations, the Committee on Science, the Division of Business Development & Management, the Committee on Economic & Professional Affairs, Presidential Event, the Society Committee on Education, and the Division of Industrial and Engineering Chemistry

**WEDNESDAY, SEPTEMBER 13**
8:30 am–11:55 am  
Marriott—Salon 11  
**Pseudoscience: What It Is and What It Is Not**  
Sponsored by the Division of Chemical Education

9:00 am–11:15 am  
Marriott—Pacific Room A  
**True Stories of Small Chemical Businesses**  
Sponsored by Younger Chemists Committee and the Division of Small Chemical Businesses
To Our Readers

This newsletter is published by the ACS Office of Graduate Education (OGE). To learn about other OGE programs, please visit our website at chemistry.org/education/student/gradeducation.html. As you will see from this newsletter, the American Chemical Society is strengthening its focus on graduate education in recognition of the importance of post-baccalaureate studies to the discipline and the profession. For individuals, learning is a lifelong continuum, but society has organized (quantized) education into levels, one dependent on another. All are important, but the graduate level is especially so because it is the gateway to progress in the chemical sciences.—Editor

Write to Us

Your letters and comments are welcome, and, space permitting, we hope to include them in future issues. Please contact us at the Office of Graduate Education, American Chemical Society, 1155 Sixteenth St., NW, Washington, DC  20036; 202-872-4588; fax, 202-872-8068; GradEd@acs.org.

We're on the Web!

www.ACSGradEdNewsletter.org