A set of ethics case studies from physics research, with an activity and discussion guide for courses and seminars in science ethics

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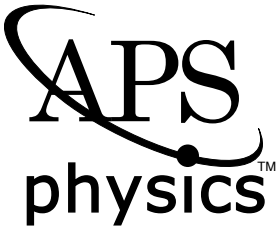

Case studies developed by the APS Task Force on Ethics Education

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Foreword

Research in physics depends on widely held values of integrity and honesty among participants. Without these values, the enterprise becomes suspect, and its results are mistrusted. It is important as scientists and educators that we demand ethical behavior on the part of all of the participants in all aspects of our enterprise. It is not sufficient to take for granted that participants are aware of what constitutes ethical behavior. For this reason the APS Ethics Education Task Force has put together this collection of case studies to provide an introduction to some of the issues that practicing physicists might encounter.

It is useful to draw the analogy between ethics education and safety training. Undoubtedly most physicists have an inherent desire to be safe, but the extent to which safety procedures are practiced in the lab depends on a range of factors, including prior experience, an understanding of appropriate procedures, and an understanding of what harm may come from failing to follow these procedures. Formal safety training is often useful to fill in the gaps not filled by prior experience. Likewise, ethics education can play the role of providing information not available from prior experience. This role is especially important for those just beginning in the field.

The reality is that ethical behavior in some instances is compromised by pressures to publish and discover, as well as by the prospect of financial gain from commercialization of certain research discoveries. The problem is complicated, because researchers may be confronted with choices in which the ethical route is not obvious. There are also differences between practices in various sub-disciplines, especially in the area of authorship of papers for publication.

An awareness of the ethical dilemmas that can occur in a professional career, and of the resources for understanding and resolving such problems, can help in avoiding ethical lapses, or limit the damage that can arise from them. Students and mentors are especially reminded that an understanding of the ethical expectations of the physics community is an important part of a physics education.

Note: The ethics case studies were prepared by a special APS Task Force on Ethics Education to promote discussion of these issues. Some of the studies were also contributed by the general population. They are based on the views of the task force members, and should not be considered to be the views of APS as a whole.

Background on the APS Task Force on Ethics Education

The APS Task Force on Ethics Education was formed in 2004, in response to several high-profile cases of ethics violations among physicists. Its charge was to advise APS on how it can best encourage physics departments to do a better job of educating their students, postdocs, and faculty about scientific ethics; to investigate what materials are available for ethics education; and to develop materials or adapt existing materials to aid physics departments in their efforts. The Task Force released a report which is available at www.aps.org/policy/statements/upload/Report_of_the_Task_Force_on_Ethics_Education.pdf

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Introduction to Ethics Case Studies

This set of materials was first created by the APS Ethics Education Task Force to provide an introduction to some of the issues that practicing physicists might encounter. Moreover, APS and the Task Force hoped these materials would generate a community-wide discussion that would improve our collective understanding of what it means to practice science.

Since the inception of this project, there has been an increase in required education on scientific ethics. In January 2010, the National Science Foundation (NSF) instated the requirement that each application for funding in science or engineering research or in education include "appropriate training and oversight in responsible and ethical conduct of research to undergraduate students, graduate students, and postdoctoral researchers participating in the proposed research project." In addition, the NSF requires institutions to provide training plans upon request, and to designate one or more persons to oversee compliance of training in the responsible and ethical conduct of research. For further information, see the first two items listed in the Resources section.

At the end of this document, and on the APS website, are a set of resources that provide further information on ethics in science and engineering research. These include books, documentation from organizations, courses, and conferences. These resources can be found by conducting an Internet search using their titles, or via links on the APS website.

Suggestions and Notes to the teacher in this Teacher's Edition are provided in this font.

This set of case studies may be used in an ethics course, ethics seminar, or group discussion on the topic. To keep the discussion lively, it is suggested that various approaches appropriate for the audience be conducted. Examples of varied approaches include: role-plays of scenarios, creating video of scenarios, or creating cartoons of scenarios. In a class setting it is imperative that class discussions occur for each topic included below based on scenarios that represent the topic. It is also recommended that discussion participants read the APS statements in the appendices before moving to the case studies. Note that it is important to move the discussions from the realm of "I feel that…" or "I think this is wrong…" to a more concrete of comparison of actions (or proposed actions) to the standards of science.

Suggestion: Consider opening up a discussion and/or collecting written descriptions of scenarios that students would like to explore. This should be done in a way to allow anonymity, for example, students could create fictitious scenarios that contain some of the issues they are concerned with. In this way, students can learn what types of questions to ask in situations and how to address situations involving unclear ethical lines. Emphasize to students the importance of learning about appropriate conduct and ethics for various situations that students may encounter during their scientific endeavors and that many of the issues transcend science.

Contents

Case Study Topics

Appendices and Resources

Conflicts of Interest

In the research environment, we are often faced with situations in which we could stand to benefit personally. These situations can include, for example, the use of university resources, telephone numbers, e-mail or web addresses to support or represent an outside activity, including businesses, hobbies and political activities. These situations constitute a conflict of interest.

Usually the technical regulations concerning conflict of interest are documented (for example in a university handbook). The regulations prohibit employees from improper participation in a variety of business transactions in which the employee may have an interest or be in a position to assist others, particularly those in whom the employee may have a direct or substantial economic interest (such as a spouse, or child). Appointments, terminations, promotions, demotions, and approval of salary increases all need to be carefully considered from the perspective of conflict of interest.

Some of the ethical issues explored in the three case studies below relate to the less documented situations: cases where there are no clear guidelines to follow.

Other scenarios that include Conflicts of Interest:
- Publication Practices Case Study: Conflict of Interest in Refereeing (p 46)
- Publication Practices Case Study: Peer Review (p 55)
- Responsible Conduct of Research and Participation Case Study: Conflict of Interest (p 60)

Suggested assignments:

1. Define conflict of interest and provide three examples.

2. Determine if the institution you are attending has documentation on conflicts of interest and, if so, describe what this documentation states.

Conflict of Interest Case Study: Confidentiality Scenario 1

You are a sixth-year graduate student at a large university in the final months of your dissertation research on novel photonic materials. You are worried about your next appointment, and have applied for several postdoctoral positions in this field plus a few tenure-track assistant professorships at universities where you would like to work. To your surprise and pleasure, you are invited for an interview for a tenure-track appointment at your undergraduate alma mater, a prestigious research institution in a city where you already have connections and would love to live.

In the question-and-answer period following your seminar on your research, the department chair asks for detailed information about the novel material-preparation technique developed in your graduate research, and used extensively in your experiments. Your group is working on a patent application and its members have agreed not to provide details until a paper currently being prepared is submitted for publication. Your thesis advisor will be giving the first major presentation on the technique at a major international conference in a couple months.

You answer that you and your colleagues are in the process of writing it up for publication and a patent application, and you would be glad to send them an early preprint when it is available. The question and answer period continues and concludes uneventfully and pleasantly.

After the seminar, in your private interview with the Chair, he pushes harder for this information, remarking that the Department seeks team players, willing to share information with department colleagues, and referring to your undergraduate roots and the need to prove you are one of them to be a viable candidate for the position. What should you do?

Questions

- What are the interests of the various players?
- Where are there conflicts of interest?
- What are your options?

Discuss students' responses before going over the discussion below. Not all discussions are included in the student text. The discussion below is in the student text.

Confidentiality Scenario 1 Discussion

There are a number of players: you, the chair, the university where you are interviewing, your graduate university, your colleagues in the graduate lab, your graduate supervisor, and the fast-moving field of nanophotonics. Each of these has different interests. You are conflicted because keeping your word may in the short term preclude your being hired at this institution. Your options include: giving the chair the information he requests, and not telling your group; giving the chair the information and telling your group when you get back; contacting your supervisor from the chair's office to attempt to get his permission to share the information (either she agrees or does not); talking the chair out of his urgency in a brilliantly tactful, yet convincing way; and refusing to provide information and storming out of the Chair's office. There may be others.

Although this may be difficult, it would demonstrate that you are a person of your word if you could talk the chair out of his urgency, by reminding him of your prior agreement to maintain confidentiality.

Conflict of Interest Case Study: Confidentiality Scenario 2

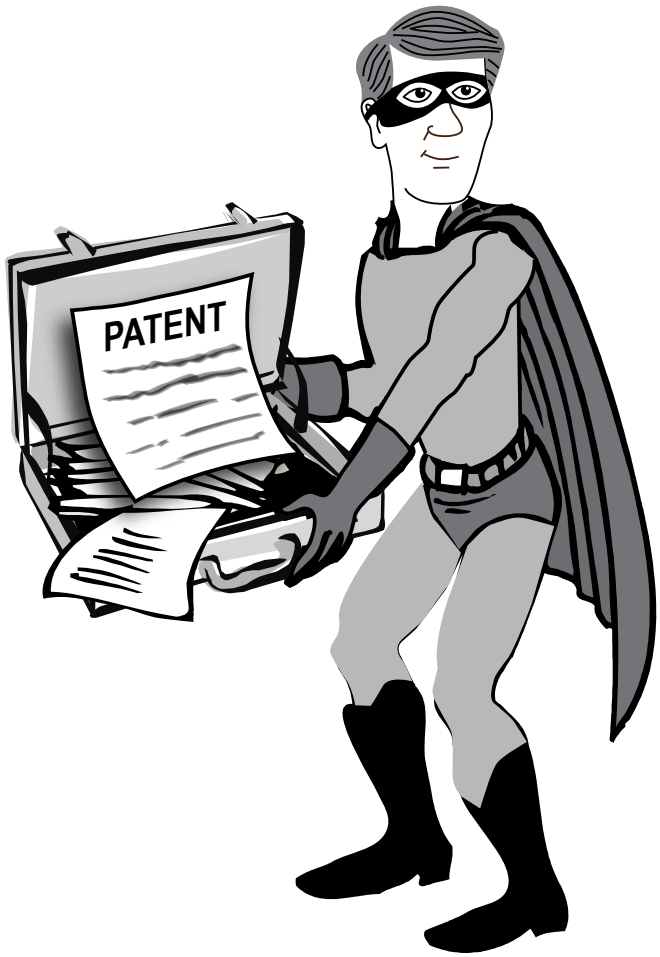
A student finishes a Ph.D. working on a problem that has aspects that are directly patentable and solve a major problem in the disk drive industry. His new job could be with Hitachi or Seagate, or some similar firm. He arrives at the new job and discovers that the work done as a student, which is in the patent process, will solve the problem at his new company. If he reveals what he knows to his new employer he will be an immediate hero, but will compromise the patent process at his original institution. This step could have important financial implications for the original institution in the form of royalties.

Questions

What are the relevant ethical considerations in this dilemma? The answer could depend on missing information, such as the nature of the contract signed by the student with his institution, if any, and the nature of its intellectual property rules. This information may have an impact on what the correct ethical response is.

Suggested assignment:

Consider asking your students to explore your institution's intellectual property rules. Have a discussion with your class about your institution's intellectual property rules and provide an example of what typically would be included in a contract at your institution.



Conflict of Interest Case Study: Confidentiality Scenario 3

A well-known theoretician at Institution A is called by an experimentalist at Institution B to discuss what appears to be a new discovery, based on a highly original approach to the measurements in question. The discovery supports the theorist's highly controversial approach to the problem. However there is a substantial amount of work needed before the results can be submitted for publication. The theorist has been invited to present a seminar at Institution C, where she is a candidate for a position, and where competitors of the experimentalist at Institution B are found. She was not told explicitly that his conversation with the experimentalist at Institution B was privileged.

Questions

- What should she do in preparing for his visit?
- What are the potential conflicts of interests?
- What ethical considerations should the theorist consider in preparing her talk?
- Are there other actions that she could or should take in preparing for the visit?

Data Acquisition

Testing of scientific theories through experimentation is at the heart of the scientific endeavor. How data are acquired, recorded, and stored is thus of fundamental importance to progress in science.

The APS Guidelines for Professional Conduct (see Appendix A) state:

> The results of research should be recorded and maintained in a form that allows analysis and review. Research data should be immediately available to scientific collaborators. Following publication, the data should be retained for a reasonable period in order to be available promptly and completely to responsible scientists. Exceptions may be appropriate in certain circumstances in order to preserve privacy, to assure patent protection, or for similar reasons.

The two scenarios that follow are intended to explore the implications of this statement.

Other scenarios that involve Data Acquisition:
- Publication Practices Case Study: Fabrication, Falsification, and Plagiarism (p 53)
- Publication Practices Case Study: Publication and Data Ownership (p 57)

Suggested assignments:

1. Write a set of procedures you might use when acquiring data for your research.

2. Discuss how these procedures help assure the integrity of the research record.

Data Acquisition Case Study: Data Handling and Record Keeping

You are a graduate student working in a lab where data are accumulated for the purposes of measuring the optical absorption of a variety of samples. For each sample there is a large data file stored on a computer in the lab. In reviewing a lab notebook from one of your predecessors in the lab and comparing that to data published by the lab, you find a gap. That is, some of the data that were published are not accounted for in the lab notebook. Furthermore, you are unable to locate the computer files for this missing data. You talk to a fellow graduate student about this situation, and he tells you that you should be very concerned about the situation and that it should be reported.

Question

What are some possible situations that could explain the "missing" data, and how should you proceed for each?

Data Handling and Record Keeping Discussion

First, it is useful to recognize that there may be several explanations for the "missing" data. Among these are

- The missing data were acquired by someone else who maintained a separate lab notebook and stored computer files differently.
- The missing data were acquired by the same person who acquired the rest of the data, but for some reason the records were not maintained in the same fashion.
- The missing data in fact never existed.

Of these three possibilities, only the third involves serious misconduct, while the other two possibilities involve problems in record keeping.

Given the information you have at this point, it is premature to conclude that misconduct has taken place. A logical first step is to find out if other people were involved in acquiring data for the publication in question. If you are unable to track down the missing data this way, you could ask your research advisor about it directly. It is more likely that this is just a record keeping problem, so avoid any questions that sound accusatory.

If you are unable to resolve the matter at this level, you should talk to a carefully chosen outside party. It is not necessarily wise to talk to fellow graduate students about the issue. It is not clear that they will have the experience or perspective to assess the situation and you may unwittingly start unfounded rumors about your lab. You could consider talking to the department head if you think he or she is an objective third party. You could also talk to your institution's Misconduct Policy Officer. Your institution's research development office can provide contact information.

Finally, it is worth noting that careful record keeping can help prevent misunderstand-ings. If someone else had collected the missing data, a cross-reference in the two lab notebooks would have been helpful. Similarly, if one person accumulated all of the data but the information was stored differently, that point should be noted in his or her lab book.

Data Acquisition Case Study: Intellectual Property

You find a novel solution to an important problem posed by your advisor; however, your advisor sees this as an opportunity for him to get published, downplays the significance of the results, collates a paper and submits it before you are any the wiser (the paper acknowledges a discussion with you, but does not include you as an author). You are absolutely clear that this idea was yours, and feel suitably put out. You approach your advisor and make a complaint, but he empathizes with you and tells you to be a bit quicker with the write-up next time. He tells you, "That's just the way of the world."

You decide not to leave it there, and approach the head of the department (going up one link in the management chain). You make your complaint to him, and he asks you for evidence, but you can't provide any because you didn't keep a dated notebook: all of your notes are in several ring binders, some at home and some in your desk at work. You start feeling a bit silly, and the head advises you to drop the matter.

Questions

- Should you drop the issue?
- Are there long-term consequences for anyone to not dropping the issue?
- Is there a "fair" way to make a claim to the results?
- In the last question, what does the word "fair" mean?
- The section on Educational Concerns has a case study about whistleblowing. Are there any whistleblower aspects to this case study?

Have a class discussion on students' responses before presenting the discussion below. The discussion below is also included in the student text.

Intellectual Property Discussion

Keeping accurate and dated notes of your ideas is a critical aspect of good scientific practice. These sorts of instances come up time and again, and irrespective of their frequency, it will only serve to give clarity to your ideas for them to be accurately recorded.

It is important for all scientists to understand how best to protect intellectual property, and keeping good notes is certainly an important aspect of this. It is also important to be aware that one's intellectual property is defined as property by law and there are means for protecting new ideas. Certainly in the pure sciences, publishing the information is the surest way to obtain credit for them, and so memo writing (leading to paper writing) is a good habit to develop: scientists must write!

So, what to do? At a bare minimum, it would be necessary for you to be included as an author on the paper: those were your ideas to start with, and your advisor does know that. Make a strong case to the department head that your concerns ought to be heard: collate your notes, and make them presentable. Inclusion as an author is not a trivial matter, and while you might not be up-to-speed with paper writing, it is important to at least be included.

Report the issue to the Misconduct Policy Officer (MPO): on most campuses there is an official who deals with matters of intellectual property. The matter is not so straightforward, in fact, and no doubt the approach will change from case to case. Foreign nationals, for example, may feel less inclined to dispute the issue, particularly if their right to work depends on their institution supporting them. (In this case, there is probably another avenue to explore, which might naturally be a foreign national liaison at the university who could be approached for advice).

Finally, there is a strong argument for the student to take notes after every meeting. Notes are not, of course, irrefutable evidence but it might carry a little more weight with the department head if the student could produce a quote of the off-hand way the professor dismisses him, especially since that quote seems to acknowledge that the idea originated with the student.

Educational Concerns

Ethics in science are primarily learned informally through mentors and by observing the behavior of those around us. For many, our experiences as undergraduates and graduate students is the first time we encounter any ethical questions specifically related to science. Issues involving data collection, authorship, and collaboration might easily be encountered the first time a student participates in a summer research program.

Ethical issues relevant to undergraduates also often involve faculty and university administrators. Conflicts that involve students can be magnified when there are imbalances in experience, status, or power.

It is important to be conscious of both the role that senior scientists have in educating students about scientific ethics and the relative lack of power of undergraduates in the academic environment. For students, it may be helpful to learn and discuss ethical standards before encountering them firsthand. Below, we include two scenarios relevant to undergraduate concerns.

There are also issues that have been grouped under this heading which pertain to activities within an academic department.

Educational Concerns Case Study: Reporting Violations and Plagiarism

You are a faculty mentor for a graduate student in your department. The student is taking some classes in another department that requires written essays. He asks you to read his essay before he submits it. You routinely google his work and discover that large parts have been lifted, verbatim, from the web with no quotation marks or citations.

For undergraduates, you could have them consider working on a group report and one member of the group is lifting web materials verbatim without proper citations.

Questions

- What should you do?
- Is there a way to monitor this student's future behavior without irreparably damaging his career?

Suggested assignments:

1. Have a class discussion on students' responses before presenting the discussion below.

2. In addition, have students check your school's web site for guidelines about plagiarism.

Reporting Violations and Plagiarism Discussion

The currency of physics is truth. Anyone who does not understand this should not be allowed to continue in physics. It is unfortunately true that many students do not understand that material from the web is not free but must be acknowledged with the same citation structure that is used for printed material. While ignorance of the law does not excuse breaking it, in many cases there is no intent to do wrong. It is also possible that this student knows he is cheating but is claiming ignorance, hoping to escape the consequences.

There are a number of options. One would be to ignore the problem. Alternatively, you could contact his instructor and discuss the problem with her. You could alert your chair that there is a "cheating" graduate student in the department. You could also tell no one else, but treat the occurrence as a "teaching moment," working with the student to help him understand the seriousness of his action and how to correct it.

An outside observer might ask whether the department discusses plagiarism in its orientation program for its new graduate students. Another question might be whether there is a way to monitor this student's future behavior without irreparably damaging his future. This is a situation in which the importance of formal ethics instruction comes to the fore.

Educational Concerns Case Study: Whistle Blowing

A graduate student has been working in a lab for a year on what she hopes will be her Ph.D. dissertation research. She has been troubled for the last several months by the possibility that her advisor may be manipulating data used in his publications. This past week, she has just discovered what she believes to be incontrovertible evidence that some of his published data had in fact been fabricated.

Questions

- What should she do?
- With whom should she discuss the issue, if anyone?
- Is there a designated person at your institution to deal with such issues?

Suggested assignments:

1. Have a class discussion on students' responses before presenting the discussion below, which is also included in the student text.

2. Inform the class who the designated misconduct officer is at your institution, if that is their title or if another title is used, the location of their office, and phone number or email.

3. Consider assigning students to research and report on the ethical misconduct of Jan Hendrick Schön, who formerly worked at Bell Labs, and the consequences that followed.

4. Check your school's web site for guidelines about whistle blowing.

Whistle Blowing Discussion

First, it is useful to remember that available (though not definitive) evidence indicates that data fabrication is rare in physics, so while the student is likely in a position where she must take some action, she should keep open the possibility that she has misinterpreted the situation. This comment, however, should not be used to justify looking the other way on the possibility that she is wrong. The question about the data needs to be resolved.

If there is going to be a formal inquiry of this matter, then it will be very important to preserve as much physical evidence as possible. At some universities, lab notebooks and other relevant material are impounded immediately upon receipt of a formal allegation of research misconduct. Preserving the evidence makes it much easier to arrive at a definitive conclusion regarding the existence of misconduct or the grounds for full exoneration. With this in mind, any actions the student takes should be consistent with the goal of preserving the evidence.

A formal inquiry into a misconduct allegation is kept confidential out of respect to both the accused and the accuser. Anything the student does prior to making a formal allegation should be consistent with this principle. This means that the student should not ask numerous people for their opinion on the matter, but rather advice should be sought from one or two trusted department members or from the university official who is likely to conduct the inquiry.

Nearly every university has someone designated as their Misconduct Policy Officer (or a similar title) who has the responsibility for initiating inquiries in response to formal allegations. The student may well need to take her allegation to this official. While it is nice to try to handle things internally (for instance working within the department), failed attempts at reaching an internal solution can make the inquiry much harder to pursue. For instance, an individual who is tipped off about a pending allegation by an attempt to resolve the issue internally has more time to cover his or her tracks and to alter or destroy physical evidence.

Health & Safety

Issues of health and safety are important in the context of any sort of experimental research. In the past, researchers and their supervisors have demonstrated a cavalier attitude towards these issues, which is inconsistent with current legal and ethical standards. It is essential that all researchers have training that prepares them for the hazards and possible emergencies that they may encounter in the course of their work, that all laws and regulations relating to safety are adhered to, and that best practices be employed when there are hazards. This means that there should be compliance with all accepted safety standards.

Researchers also have an obligation to carry out their work in a manner that does not threaten the health and safety of others, and to be forthcoming in identifying new risks and to be rapid in their response to hazardous conditions and emergencies that may arise. Health and safety standards are usually rigorously followed in large laboratory settings. It is important to recognize that they must be followed even in the most modest of research settings.

Suggested assignment:

Consider the questions:

1. What are the safety standards you need to follow with your work?

2. What are some common safety standards that are followed in undergraduate lab work?

Most institutions have designated personnel in charge of safety issues and/or an environmental health and safety department. Provide the class with the names of designated personnel responsible for safety issues in your department, and if applicable, the location and numbers of the department responsible for safety concerns at your institution.

Health & Safety Case Study: Hazardous Materials

A condensed matter experimentalist and his students were conducting experiments on thin films of common metals such as aluminum and tin. They realized that they could substantially enhance their work by switching the samples to the metal beryllium, which is highly toxic and can bring about irreversible poisoning. The procedures that they are employing with aluminum and tin would not be suitable for a toxic material such as beryllium.

Questions

- What responsibility does the PI have in considering the new, potentially dangerous material for the research?
- What role should the students have in making this decision?
- If there is a decision to go ahead with the work, what is the PI's responsibility in terms of providing information and training?
- How should he or she proceed with setting up these new experiments in a manner that might ensure the safety of his students?

Have a class discussion on students' responses.

Research with Human Subjects

Physicists occasionally perform research involving human subjects. Examples of such research include educational studies, biophysics investigations, and surveys.

Federally funded institutions are required to have appropriate procedures in place to ensure that the health and privacy of human subjects are protected. Institutions generally have one or more committees set up to review proposals for research involving human subjects. Certain types of minimal-risk research may be exempt from oversight, including some forms of education-related research. However, the investigator is not allowed to make the determination of exempt status on his or her own; the institution's human subjects review board makes that decision. The regulations governing human subjects research are lengthy and complex. Fortunately, another requirement of federally funded institutions is that they make human subjects research training available. Taking advantage of these training resources is likely to be a more efficient way of finding out the information most relevant to you.

Detailed information may be obtained from the Office for Human Research Protections in the U. S. Department of Health and Human Services (www.hhs.gov/ohrp).

An article entitled "Human Subjects Research Training and PER [Physics Education Research]" appears in the Fall 2010 edition of the APS Forum on Education Newsletter at www.aps.org/units/fed/newsletters/fall2010/sitaryhomsen.cfm

Suggested assignments:

1. Provide an example where human subjects might be used in your department.

2. Find out if this institution is federally funded and the location and title of any human research review board that exists at your institution.

Provide for students information on procedures for research involving human subjects and, if applicable, how to access the human research review board that oversees your department.

Research with Human Subjects Case Study: Education Research

Suppose you have a strong interest in physics education, and in pursuit of that interest you want to assess the effectiveness of two different strategies for running recitation sections in large introductory physics courses. The professor who runs the course agrees that both of your proposed strategies have educational merit and that you can try them out on two independent sections of the class. At the end of the term, you discover a clear difference in test performance between the students in the two different groups. You want to give a talk at an American Association of Physics Teachers meeting about your results.

Questions

- What steps do you need to take in order to ensure the privacy of the students is adequately protected?
- Do you need Human Research Approval in order to give the talk?
- If you receive permission to give the talk, what additional steps do you have to take to protect the privacy of your students?
- Are there consequences to giving the talk without asking about Human Research Approval?
- Does this violate any ethical guidelines?

Have a class discussion on students' responses before presenting the discussion on the next page.

Education Research Discussion

While many physicists never face issues associated with human subjects research, those who do education-related research or who take surveys of the physics community may face such issues. Every university that receives federal funding is required to have a review board to oversee research involving human subjects. Research on how students respond to different teaching methodologies would fall under this category. Federal regulations exempt education research from formal oversight provided the results are intended to improve one's own instructional delivery and provided the results are not disseminated outside one's own institution. Other specific conditions may apply.

Generally, a university will require faculty and students to submit for review any research project involving human subjects, regardless of whether the researcher believes the project is exempt. The review board may then decide that the project is exempt, or it may make specific recommendations to ensure the rights of the subjects are appropriately respected. Typical precautions include having a plan to ensure the privacy of the subjects is maintained and a mechanism for obtaining informed consent from the subjects prior to the start of the project.

Issues of Bias

Webster's New World Dictionary[1] defines bias as "a mental leaning or inclination; partiality; prejudice; bent." Scientists are expected to be objective, and open to learning the truth from their research. Yet, physicists are also human. Each of us has our own likes and dislikes, preferences and preconceptions, and "hot buttons" that make us feel angry, uneasy, or uncomfortable. Bias can damage research, if the researcher chooses to allow his bias to distort the measurements and observations or their interpretation. When faculty are biased about individual students in their courses, they may grade some students more or less favorably than others, which is not fair to any of the students. In a research group, favored students and colleagues may get the best assignments and helpful mentoring. People often prefer associating with other people who are similar to themselves, their family members, or their friends.

The net result of these biases hurts physics, because people who are different and would bring valuable new perspectives to the field have traditionally been excluded or discouraged by those already in the field. It is not unusual for women, African Americans, Hispanics, and Native Americans to feel unwelcome in physics and other scientific fields, because of the low expectations their professors and colleagues have for them, and because of how they are treated by the people who should be their peers and colleagues.

While it is probably impossible to eliminate bias, each person can strive to be aware of his or her preferences and alert to situations where the bias can be damaging to the science or one's colleagues. Also, one can become a careful observer of others, and take action to counteract the unfair or inappropriate consequences of biases, especially those that work to exclude or diminish people from different backgrounds than the majority.

[1] *Webster's New World Dictionary of the American Language,* David B. Guralnik, Editor in Chief, Second College Edition, William Collins + World Publishing Co. Inc. (1978).

Issues of Bias Case Study: Bias in Hiring

You are a female physicist applying for a position you want very much at a prestigious, albeit relatively conservative, university. During the interview process, you are asked about whether you have a husband or significant other in the same field.

Questions

- Should you answer this question?
- What implications might your answer have on the search committee's attitude toward you? (consider both the positive and negative answer)

During a class discussion of this issue other similar issues might arise such as whether the applicant has children. Encourage discussion on these and other issues of bias in hiring that might include age, health, disabilities, and/or ethnicity.

Issues of Bias Case Study: Reaction to Bias

The graduate students, post-docs, and professor in your research group have spent the past week brainstorming ideas for a major new proposal to submit to the National Science Foundation. After much discussion, the professor selects Sally's idea to be the core of the proposal, and invites John to be Co-PI with him, and to take the lead in coordinating preparation of the proposal. Both Sally and John are senior post-docs in the lab. It is a real honor and a career advantage to be a PI early in one's career. By offering one of his post-docs the opportunity to be Co-PI and work with him on preparing the grant, the professor is helping launch the post-doc's career. The issue is, why didn't the professor offer this opportunity to Sally, since the core idea in the proposal was hers?

Questions

- In considering this scenario, how should the different students and post-docs respond to this decision by the professor?
- What should Sally do?
- What are John's responsibilities?
- Is it unrealistic to suggest to John that he express his concern to the professor?

Most students have experienced situations where they have worked within a group in which some form of bias or unfairness has occurred. Encourage students to draw from their experiences of bias within a group during class discussions on this topic. Note that the discussion needs to be focused on bias, and that issues of other types of unfairness can be addressed later. You could assign students to discuss other issues that arise during group work as a written assignment and to describe procedures that might ensure the reduction of these issues. The discussion below is included in the student text.

Reaction to Bias Discussion

Post-docs are quite dependent on their advisors for future career success. The decision by the professor as presented above is biased and unethical. This is a situation in which an ethical response by John, even though it involves risk, would be essential. Sally should try to talk to John and convince him to behave ethically, and speak with their professor. If that does not work, consulting with a trusted faculty member who could talk to the professor about her concerns could be an option.

Mentoring

Mentoring is the act of providing resources to encourage healthy growth. Mentoring can involve individual relationships ranging from a casual offer of advice up to an apprentice relationship. Mentoring implicitly involves expectations; both the mentor and the mentee should have realistic and well understood goals for the timing and product of the relationship. The ethics of one-on-one mentoring involves how the mentoring expectations are formulated and met.

Working in a mentoring atmosphere can be as important as the availability of one-on-one help. Group leaders, from department chairs to research directors, have an ethical obligation to create an environment that supports fair treatment and professional development opportunities for all group members. With such broad ethical responsibility, mentoring issues can overlap with issues of bias, health and safety, and maintaining the intrinsic ethical standards of the discipline.

Most students will mentor someone during their college experience. Discuss with the class the different situations that may occur in which the students may be mentors or mentees.

Suggested assignments:

1. If a mentee had a grievance with his or her mentor in your department, what procedures do you think they should follow? Who should they talk with first?

2. Suppose you are a tutoring a younger student and have agreed to help them through the next set of exams. Suddenly you are overwhelmed with your own classes and find you need to spend more time on your classes then you expected. What do you do?

Many of the scenarios presented below lend themselves to role plays. Consider having students act out the scenarios to the class. Suggestions are provided in what follows.

Mentoring Case Study: Mentoring Scenario 1

You enter graduate school with two full years of support from a fellowship awarded by your undergraduate institution. You easily find a faculty member to work with. At the end of the second year, the faculty member tells you that she will not be your thesis advisor.

Consider having students role-play this scenario:

Student: I've been so lucky! I've had two full years of support to work on this research topic. Do you think I've reached the half-way mark for my thesis work? When do you think I should start writing up my thesis?

Professor: Hmmm. You've done a lot of work on this topic and certainly have progressed well, but I think there has been a misunderstanding. I am not going to be your thesis advisor.

Questions

- What should you do?
- Was the behavior of this faculty member ethical? Why or why not?
- How is the behavior of this professor different from the assistant professor in Scenario 6?
- Can you design a faculty scenario for this situation that would make her behavior ethical?
- What should be the response of the department to this situation?

The discussion for Scenario 1 is included in the student text. Discuss students' ideas before discussing the information below, which follows Mentoring Scenario 2.

Mentoring Case Study: Mentoring Scenario 2

You are a third-year graduate student working in theory. Your research professor has not provided you with a problem, and seems uninterested in the work you are doing on your own.

Consider having students create a role-play this scenario. An example follows.

Student: I've been working on this problem for a year now. What do you think of my calculations?

Professor: (In a flat tone) They're fine.

Student: Do you think I should work on a different problem? Do you think working on this problem will be sufficient to produce a thesis?

Professor: I don't know if this problem will be sufficient to produce a thesis. Have you looked into similar work on it?

Student: Yes, I have looked into similar work. I think it is a good problem. Do you think there is a better problem for me to work on?

Professor: I'll have to get back to you on that. Talk to you in a few weeks.

Student: (Muttering under breath) That's what you said months ago.

Questions

- What should you do?
- What commitments were made to this student when she was accepted as a thesis student?
- What kind of supervision should a graduate student expect from a thesis advisor?
- Should a student expect substantive and appropriate help from an advisor, or are there different supervision styles, all of which are appropriate?

Have a class discussion on students' responses before presenting the discussion below.

Mentoring Scenario 1 Discussion

At this point, all you can do is find a new advisor. Going back in time, the mistake you made was to assume that the person who took your first two years of free research availability would automatically supervise your thesis work. If you have this kind of support, be very sure of the continuation of the research relationship once the support is gone.

Mentoring Scenario 2 Discussion

The point to be established is whether or not the faculty member is serious about supervising your thesis research. Opening a discussion of possible thesis topics is one way of assessing the situation. Either the discussion will lead to a narrowing of thesis possibilities, or it will become clear that no thesis will result. Either way you are ahead, because you will not have wasted more time.

Mentoring Case Study: Mentoring Scenario 3

(From the student point of view) You are a second-year graduate student in physics and have just failed the qualifier for the second time.

Question

What should you do?

Discuss with the class their ideas before presenting the ideas below.

(*From the point of view of the graduate program chair*) Several graduate students in the program have just failed the qualifier for the second time.

Question

What should you do?

Have the class discuss their ideas before presenting the discussion related to this scenario below.

Mentoring Scenario 3 Discussion 1

The most likely reason that you are failing the qualification exam is your background in undergraduate physics. Some students, as undergraduates, do not acquire the physics framework that would support graduate work in physics. They could have been simply very good at passing exams but did not assimilate the material, or their exposure to advanced undergraduate physics might have been deficient.

All possible remedies start with a discussion with the graduate program head. Once you have admitted your problems, the possible remedies might include grading in the advanced undergrad physics courses, or simply sitting in on undergrad courses for no credit.

Mentoring Scenario 3 Discussion 2

Students accepted for graduate study in US institutions are not dumb. If a student is failing the qualifier, you should find out why. A discussion with the student and with the student's teachers is a necessary part of the process.

Points that an outside observer might raise: Should the program chair or counselors be aware of the classroom performance of graduate students before they take the qualifier and arrange appropriate counseling and learning opportunities to insure success? What kind of counseling was offered to the students after their first failure? What is the attrition rate for graduate students in this department? Some institutions do not have a qualification exam. Are their students less able than yours? Is the success rate of their students as professional scientists less than the success rate of yours? This scenario opens up the question of whether a program uses exams to weed people out. Some programs have a reputation for intentionally accepting more students than would pass the qualifier or comprehensive because they needed the teaching assistants.

Mentoring Case Study: Mentoring Scenario 4

You are a minority graduate student studying at a good university. You are having trouble with your graduate coursework because your undergraduate institution did not offer intensive courses in some upper level physics areas. Your first term grades were marginal. During the second term, the faculty member in charge of the graduate program asks you to attend a physics meeting aimed at minority scientists to help the department recruit new minority graduate students. You are flattered, but are worried about missing class work.

Question

- What should you do?
- What questions might an outside observer have concerning this situation?

Discuss with the class their ideas before presenting the ideas below.

Mentoring Scenario 4 Discussion

This may be an opportunity to open a discussion with the graduate program head about your difficulties. A straightforward admission of your problems and your worries about missing class might lead to mentoring opportunities that will help you in your classes. If the graduate chair is not approachable, then a similar discussion with your professors might also provide some positive benefits.

Points that an outside observer might raise: Is attending the meeting an appropriate (ethical) request to make to this student? If a student were worried about classroom performance, would he or she be afraid to refuse the request of his program chair? Is there a better way to recruit students to attend meetings of this type than targeting individual students? Have the graduate counselors in the department worked with this student in planning an appropriate program? If the graduate chair is not viewed as approachable by the student, why not? It is not always easy to confront personality issues in a department, but one way or another, a department needs to make advisors or program coordinators available whom students feel able to talk to.

Mentoring Case Study: Mentoring Scenario 5

You are a student from a very small undergraduate institution, accepted for graduate study in a prestigious university. Your first year is covered by a scholarship. When you arrive, your advisors place you in the standard first-year graduate classes. You have doubts about your background.

Questions

- What should you do?
- What are some possible questions an outside observer might ask?

Discuss with the class their ideas before presenting the ideas below.

Mentoring Scenario 5 Discussion

There are several factors to consider in this scenario. The first is the courses that you elect to take during your first term. Your options are:

- Accept the placement because you don't want people to think you can't handle the graduate work.
- Insist on taking some advanced undergraduate courses your first term to check your preparation.
- Try a combination of graduate and undergraduate classes, focusing the undergraduate work in areas where you doubt your preparation.

Which option you pick depends on your preparation. It is important to realize that you are in charge of what happens to you.

Two of the ethical concerns in mentoring are recruiting students under false or incomplete pretenses, and making sure that student responsibilities are substantive and appropriate.

The questions an outside observer could raise regarding the departmental behavior are: When this student was accepted, did the admissions committee discuss her deficient background? Why was she accepted with a poor background? Is the student a member of a minority group and the acceptance tokenism? The student was given a scholarship. Was this in recognition of her need to spend more time on classwork than others? Is this department being pushed by the institution to enroll more underrepresented students? Do the first-year counselors regard the students they counsel as individuals to help or as a burdensome service assignment? This scenario is challenging in that it represents an aspect of advising fairly realistically. How do we know if a student is underprepared?

Mentoring Case Study: Mentoring Scenario 6

(*From the perspective of an untenured Assistant Professor*) In January, a student approached you to be his thesis advisor, and you agreed. During the subsequent semester, you found that he was taking more of your time then you were really able to give. He was not at a point where he could effectively contribute to any of the calculations that you had in hand. He would frequently give you his own calculations for comment and, because of other time constraints, you usually were not able to read them in a timely way. While you would have preferred a student with more independence, you thought that the situation might improve over time. In May, a senior colleague in your group left, and his advanced graduate student opted to stay at your university rather than accompany your colleague. You were pressured by your department to take this student. As the summer progressed, it became clear that you could not effectively deal with both students and do all of the research that was needed in order to present a good tenure profile. Your options seem to be to cut the first student loose or to keep both students.

Questions

- What should you do?
- What points would you consider in your decision making?
- What questions might an outside observer have?

Discuss with the class their ideas before presenting the ideas below.

Mentoring Scenario 6 Discussion

One of the ethical concerns in mentoring is the recruiting of students under false or incomplete pretenses. In this case, the student was not recruited by the faculty member but was accepted as a thesis student. While there was no "pretense" initially involved, there could be a developing element of dishonesty if the student is not informed about the evolving situation. The two levels of ethical concern in this scenario are the decision to be made by the faculty member and the behavior of the department.

Points that the faculty member might consider: What commitments did you make to the younger student? Did you discuss a timeline toward a degree? Was this student given any indications that you were considering dropping your commitment to thesis supervision? Did your department behave fairly (ethically) in pressuring you to take the second student? Were you promised any extra resources for accepting her? Were you told that it would help your tenure? As the situation deteriorated, did you discuss the problem with your department chair?

Points that an outside observer might raise: Does this department have a strong commitment to developing graduate students into professional physicists? What is the attrition rate for graduate students in this department? Does this department have a strong commitment to helping assistant professors achieve tenure? Was it ethical to pressure the faculty member to accept the second student? What kind of pressure was applied?

If the faculty member elects to terminate the student, would she be treated fairly by the department after she was terminated? Many departments require a thesis advisor for advanced students to be in good standing and to receive support. When the student was recruited for this graduate program, what kind of assurances was she given about departmental support? Would these assurances be honored if she were terminated?

Mentoring Case Study: Responsible Mentoring, Disabilities

A young graduate student in the middle of his thesis research is diagnosed with a debilitating chronic disease. The recurrence of the condition results in his being absent from the laboratory for extended periods of time. Ultimately he falls seriously behind in his research. This poses a dilemma for his mentor, who, while wanting to be supportive of the suffering student, has an obligation to his research sponsor to be productive scientifically.

To complicate matters, the student is from another country, and if he loses his student status, he will have to leave the US.

Question

What course of action should the mentor take that might not undermine the student, and yet at the same time carry out his responsibilities?

Suggested assignment:

You are assigned to a student group with the group's task of completing a class project. The project is worth half of your grade, and involves researching a physics topic such as infrared spectroscopy, designing and carrying out an experiment, and presenting your findings. You find out in the middle of the semester that one of your group members is diagnosed with a debilitating chronic disease. Treatments of this disease cause the student to be absent and to have trouble concentrating on the project.

Questions: What would you do? Who should you talk with? What do you think your fellow student with the debilitating disease should do? How do you think the professor and institution should handle the situation? How would things change if the student just became a parent or just lost a family member? What if it were your professor who had the debilitating disease rather than your fellow student?

Discuss with the class their ideas before presenting the ideas below.

Responsible Mentoring, Disabilities Discussion

One approach the professor might take is to apply the same standards as best he or she can that other employees at the university would have. Most universities have an office that handles issues pertaining to students with disabilities. By contacting that office, the professor can first find out what the legal requirements are. The focus can then move to what other accommodations, if any, should be made for the resolution of the situation to be ethical.

Publication Practices

The *APS Guidelines for Professional Conduct* (see Appendix A) state that authorship should be limited to those who have made a significant contribution to the concept, design, execution or interpretation of the research study. All those who have made significant contributions should be offered the opportunity to be listed as authors. Other individuals who have contributed to the study should be acknowledged, but not identified as authors. The sources of financial support for the project should be disclosed.

Plagiarism constitutes unethical scientific behavior and is never acceptable. Proper acknowledgement of the work of others used in a research project must always be given. Further, it is the obligation of each author to provide prompt retractions or corrections of errors in published works.

The case studies in this section are designed to explore some of the subtleties that may arise in the application of these standards.

This might be a difficult topic for undergraduates to relate to, and a new topic for beginning graduate students. Consider providing students with an analogy, for example students could think of this situation as similar to working with a group of students to complete a final report for a class. Everyone's grade depends on the final report.

Publication Practices Case Study: Authorship and Collaboration

Scenario 1

You are involved in a collaboration, and research results are about to be published.

Question

What factors will determine if you will be listed as an author, and if so, where your name will appear on that list?

Discuss with the class their ideas before presenting the ideas below.

Scenario 2

A dispute over the correct interpretation of data arose within a three-person research group. An agreement couldn't be reached, so one author (Smith) decided to publish separately. The other researchers in the group thought they would wait to see whether Smith's paper was accepted.

Smith moved to a new institution in the interim, but the notice of acceptance and manuscript number were faxed to the old institution, and Jones, the former research partner, learned of it. Jones then contacted the journal, said that Smith's paper was wrong, and asked to be allowed to submit an alternate version of the material.

Questions

- If you were the editor, how would you respond to this problem?
- What if the disagreement were the result of a long-standing dispute between the two authors?
- How might the researchers have avoided this situation?

Scenario 3

A collaboration is established between your institution and another one halfway across the country, and so it will be a rare occasion that you will interact in person. Your group will be providing some much needed simulations to help understand their experimental results.

In working on the problem, you discover some important physics that has been overlooked by your collaborators, so fundamental that it really needs to be published immediately. You quickly write a paper (with you as first author) on the subject with the colleagues at your institution and use the results from the experiment from your collaborators, then circulate the submission draft to your collaborators. The next morning you receive a rather terse phone call from their lead scientist telling you that if you submit the publication, the collaboration will terminate there and then, and you will lose the collaborative grant: they are outraged that you are publishing their results with you as first author.

Question

You are faced with a dilemma: publish the important discovery and ruin the collaboration, or drop the matter. An alternative could be to offer the collaborators the opportunity to be first authors on the paper. What should you do? This is a matter of the breakdown of trust.

Discuss with the class their ideas before presenting the ideas below.

Authorship and Collaboration Discussion

Scenario 1

The size of the collaboration will make a difference. Large-scale collaborations, such as high-energy physics experiments involving hundreds of people, tend to have more clearly defined procedures for deciding who will be listed as an author and in what order. While it is useful to have a common understanding at the start of collaboration, often this understanding is not explicit at the beginning of a small-scale collaboration. Nevertheless, the APS standard applies: all who make a meaningful contribution to the scientific work should have the opportunity to be listed as an author.

What contribution is considered significant from a scientific perspective is not always clear, particularly when technical work is involved. Lab technicians are generally not listed as authors if their prime responsibility it is to maintain equipment. On the other hand, a beginning student may first do primarily similar technical tasks while getting a feel for the experiment, and it is not unusual for their name to be put on a paper for performing very similar work.

Standards for determining the order of authorship vary widely from field to field. In most fields, having the lead author position is considered most desirable and likewise would be indicative of having made the greatest contribution to the paper. The lead author is often, but not always, the individual who took responsibility for writing the first draft. However, traditions vary from field to field and collaboration-to-collaboration, so it is difficult to generalize. If position on an authorship list is of concern to you, it may be wise to explore this issue early on in collaboration.

Lastly, it is important to remember that being listed as an author carries responsibility, not only during the research and writing, but also after the paper has appeared in print. If an author becomes aware of a significant problem in a paper, then that author has a responsibility to make reasonable efforts to correct the written record.

See the American Physical Society's *Guidelines on Professional Conduct a*nd Supplementary Guidelines on Responsibilities of Coauthors and Collaborators, in Appendix A, or at www.aps.org/policy/statements/02_2.cfm

Scenario 3

Collaborations are awkward arrangements at best: usually an agreement is made early on as to how specifically each group will interact, and what specifically will be the roles in publication. To stray from that initial agreement is construed as underhanded, so it is necessary to spell things out explicitly ahead of time.

However, there is a typical courtesy in collaborating with external institutions, and it is reasonable even in the absence of an agreement for the other group to expect to be consulted prior to submitting a paper with their data; if the data have not yet been published, then some of them would normally expect to be co-authors.

Matters of breakdown of trust usually require arbitration: if the initial agreement has been broken then an outside mediator may be needed (how does one actually resolve this issue?). However, before the collaboration even

begins, it is necessary for each group to be in agreement on who gets to write up what.
Usually the matter can be resolved between the PI's in the two groups. In this example, improved communication between the two groups, both initially and ongoing, would include all new physics issues to be encountered and developed collaboratively.

Publication Practices Case Study: Conflict of Interest in Refereeing

A young referee claimed to have been coincidentally working on the same problem that appeared in a paper he was sent to review. He made a positive review, and then went on to publish his own paper on the subject. The original author took note, and complained to the journal. When approached, the referee pleaded with the journal that his institution not be contacted, apologized profusely, sometimes tacitly admitting and sometimes denying any guilt.

Questions

- What action should the journal in question have taken?
- Should the editors notify the referee's institution?
- What should the author have done to avoid this mess?

Discuss with the class their ideas before presenting the discussion, which appears after the "credit for work" case study.

Publishing Practices Case Study: Credit for Work

As a graduate student, you have worked closely with a professor and her post-doc on a project studying experimental techniques in microfluidics. The project is going very well and you've even published some of your initial results. You will be graduating this spring with your master's degree.

Your advisor is now writing a subsequent paper with a colleague who is developing a theory that accounts for your results. You see a draft of the paper and notice that you are not listed as one of the four authors of the paper, who are the professors and their senior post-docs. However, the paper is directly based on the work that you did, and includes a new experimental plot that you created in addition to the theoretical calculations.

Question

What should you do?

Suggestions:

Remind students that the appendix contains the APS Guidelines on Professional Conduct *and* Supplementary Guidelines on Responsibilities of Coauthors and Collaborators.

Consider having students role-play how they might approach the situation.

Discuss with the class their ideas before presenting the ideas below.

Conflict of Interest in Refereeing Discussion

This problem emphasizes the importance of avoiding (whenever possible) even the appearance of a conflict of interest. The author initially should have returned the manuscript unread, and not attempted to referee it. The editors, given what occurred, should notify the referee's institution and leave disciplinary action to it.

Credit for Work Discussion

The question of authorship can seem a bit vague as you begin a research career, but anyone who made significant contributions to the research should generally be included in the author list. The specific guidelines accepted by the APS state that "all those who have made significant contributions should be offered the opportunity to be listed as authors."

If you believe that you made significant contributions, one possibility is to simply ask your advisor directly whether you will be included as an author. It could be that she has not specifically thought about the author list yet or has other plans for publishing your contributions to the project. If you do not feel that you've gotten a satisfactory answer, a trusted faculty member who is not involved with your research group might be able to provide guidance on what is typical and appropriate. If that fails, consulting the department head or the departmental ombudsperson would be appropriate.

Publishing Practices Case Study: Dual Submissions

A newly minted Ph.D. has taken up a position at a government laboratory. His early work has been extremely successful, and on the suggestion of his group leader, he put together a manuscript describing their joint work, and submitted it for publication in a high-impact journal. The young scientist was the submitting author.

Some weeks later his supervisor came to him and told him to submit the same manuscript to a specialized journal where the time to publication might be a lot shorter, and the potential refereeing gauntlet would likely be less of a hassle. The supervisor suggested that they could withdraw their manuscript from the extra journal if the other accepted it sooner.

Questions

- What should the young scientist do?
- If the scientist follows his supervisor's advice, what should the editors do?

Suggestions:

Facilitate a discussion on students' ideas. Have students review submission guidelines for a journal (such as APS journals). Submission guidelines can be found online and in a copy of the journal.

Discuss with the class their ideas before presenting the ideas below. The discussion below is included in the student text.

Dual Submissions Discussion

The young scientist is faced with an ethical dilemma. If he complies with his supervisor's wish, he will have the same manuscript submitted to two different journals. If he does not comply, he runs the risk of alienating his supervisor during a probationary period.

In the end he chose to follow the suggestion of his supervisor. The two journals then asked the same referee to read the manuscript, and as a consequence, the dual submission became known to both editors. The editors are then faced with the problem of actions which could terminate the career of the young scientist, or a more merciful approach.

Do both editors have the obligation to reject the paper outright, or should the author be asked to withdraw one of the submissions, and to apologize for his actions? Is it ethical for either editor to accept the paper, given the actions of the author?

The following statement is from the APS publication guidelines (https://authors.aps.org/esubs/guidelines.html): "Manuscripts submitted to the journals must contain original work which has not been previously published in a peer-reviewed journal, and which is not currently being considered for publication elsewhere."

Consider discussing with the class the following comments, which were posted online at the APS website.

The following comments were posted by individual APS members, and do not necessarily reflect the views of the Task Force on Ethics Education or of APS itself.

— Posted 05/09/07

I do not think that the editors of both journals should reject the paper outright. The rejection of the paper should be based solely on the unsuitability of the paper. The submission of the same paper to two different journals should be avoided by all authors. However, it is not unethical to SUBMIT the same paper to two different journals. It surely is unethical to get it PUBLISHED in two different journals. If the paper has been accepted in one journal, the authors have obligation to withdraw it from the other journal. Similarly, the editor of other journal have obligation to ask the authors to withdraw their paper, once it is known that it has been accepted for publication by the first journal. Action might be taken if the authors don't comply and it is later learnt that the same paper was published in two different journals. Submitting the same paper to two different journals does not necessarily mean an intent to publish the same paper in two different journals.

— Posted 05/22/07

This is a reply to a comment on duplicate submission. The writer argues that it is acceptable to submit to two journals at once. But the APS Submission guidelines state that "Manuscripts submitted to the journals must contain original work.....which is not currently being considered for publication elsewhere." The APS copyright transfer form contains a similar statement. Absent these warranties by the submitting authors there would be nothing wrong with duplicate submission, but it becomes misconduct by violating them. Virtually every

scientific journal contains such statements, and with good reason. All journals are swamped with submissions, and there is appreciable expense of Editors' time as well as overworking of referees for each submission. Duplicate submission means that at least one journal will have done this work for no reason. And if every one of the 30,000 submissions received annually to APS journals were to be submitted elsewhere as well, we would create one huge overload! That said, in the case discussed we must consider the dilemma of a young researcher. Certainly the professor should receive a greater share of the blame. But the APS journal would simply reject the article for violating this agreement. Unethical behavior is certainly a reason for rejection. The only question remaining would be whether we tell one or more of the authors that their papers will not be considered for several years after that. I would guess that the young author would be let off, but would have to submit this one article to another journal after it is rejected. It is not acceptable for an author to violate one of the warranties that accompany submission.

Publication Practices Case Study: Errata in Previous Research

A research group publishes a couple of papers on an important discovery in two different high-impact journals. A new graduate student is given the task of reproducing and extending the work of the advisor and a post-doc. After several weeks of experimentation, he realizes that he cannot reproduce the work reported earlier. He even has an explanation for the error.

Questions

What are the optimum courses of action for the student, the advisor, and the post-doc, who, in the interim, has left to take up a new job?

Suggestions:

Consider having students role play the situation and the actions they would take to deal with the situation.

Discuss with the class their ideas before presenting the discussion, which appears after the Fabrication, Falsification, and Plagiarism Case Study.

Publication Practices Case Study: Fabrication, Falsification, and Plagiarism

You are a co-author on a recent paper that was rejected. The referee made a couple of good points that called into question a section of the paper. The lead author, a fellow graduate student, is responsible for rewriting this section of the paper.

When you read the new version, you see that he has changed some of the numbers to address the referee comments. His response to the referee is that upon double-checking the data, there was indeed a mistake, and the referee was correct in noticing something was amiss.

This student hopes to graduate within the next year, and you are aware that he is desperate to publish something before starting a job search. You are skeptical of your lab-mate's explanation for the error, but don't have any specific knowledge of wrongdoing.

Question

What should you do?

Alternative Problem

A PI, who is desperate to publish in order to secure a grant renewal, has just been told by his junior student of concerns about the above paper. How might or should a PI in this situation respond to this concern?

Have a class discussion on students' responses before including the discussion below.

Errata in Previous Research Discussion

First, it is essential that the former post-doc and the student publish an erratum. It would be inappropriate for the new student to be a co-author of the erratum, but when the error is completely understood, he, and perhaps the advisor, could publish a paper about the physical phenomena that were overlooked earlier. The student should get an acknowledgment in the erratum, but should be consoled by the fact that a new paper might come out of the corrected results.

Fabrication, Falsification and Plagiarism Discussion

Mistakes can certainly occur in drafting a paper and it's unwise to make accusations before knowing the full story. If you have questions, as a coauthor of the paper, it is reasonable for you to be satisfied that the revised paper is complete and accurate. You can certainly ask your coworker for clarification without accusing him of altering the original data. If you were worried that he will feel accused in any case, this would also be a question for your mutual advisor. As the PI for this research project (and likely as someone who has refereed many papers as well), your advisor might be in the best position to judge whether the explanation is appropriate.

Publication Practices Case Study: Peer Review

Over lunch one day, your advisor tells you that he is reviewing a paper unfavorably. He rationalizes that the group that is performing the work is in direct competition for funds with your group, and thus seeking to undermine the work would benefit your group. After all, funding is really tight.

It is obvious to you that your advisor has put himself in a position of conflict of interest, and is not being fair in his review of an otherwise credible piece of scientific research. Your advisor further complicates the situation by asking for your input, given that you are also working directly on one important aspect of the work. You read the paper, and find it plausible.

Question

What should you do?

Discuss with the class their ideas before presenting the ideas below.

Peer Review Discussion

First of all, conflicts of interest come up routinely when paper reviews are performed. It is usually necessary to report any conflict of interest when reviewing a paper, or performing reviews of a grant. Often papers are used in support of a future proposal for a grant renewal, and so publication can be very political, especially between rival groups, and particularly when there are precious few experts to review the work.

Some people talk about "managing" a conflict of interest rather than eliminating it. That is, if you are doing research in a field that does not have many other people working in it, then reviewing a paper or proposal of a potential rival is almost unavoidable. The best we can hope for under those circumstances is disclosure of the conflict while making a good faith effort to provide an objective review.

So what should you do? You should discuss the issue with your advisor: is he aware first of all that he is in a position of conflict of interest? Without giving a lecture on ethics try just opening up a general discussion with your advisor about how the peer review system works. If that discussion confirms an impression that the advisor is manipulating the system, then consult another senior colleague.

The following resources may be useful:

- APS Journals Instructions to Referees (http://publish.aps.org/refinfo.html)
- NSF Guidelines for Reviewers (www.fastlane.nsf.gov, click on "Proposal Review")

Publication Practices Case Study: Publication and Data Ownership

A graduate student became impatient with the care his advisor was taking in making certain of the correctness of their joint experimental work. He decided that he could wait no longer to publish a paper. On his own, and unbeknownst to his advisor, he wrote up a manuscript and submitted it to *Physical Review Letters* with his advisor and some other students as co-authors.

The editor at the time became suspicious of the manuscript, because of the writing style, and the fact that the advisor, as senior author, did not submit it. He phoned the advisor and asked him if he had been a party to the submission. It turned out that the advisor did not know about it at all.

Question

What should the advisor do about the manuscript and about the student's ethical lapse?

Discuss with the class their ideas before presenting the ideas below.

Publication and Data Ownership Discussion

This scenario involves at least two ethical issues: submission of a manuscript with co-authors who have not been a party to the writing, and ownership of data. The actions of this student clearly violated traditional views regarding these matters.

The real dilemma is that of the advisor. What should he or she do about this student's clear ethical violation? This is a situation in which the student's career could justifiably be terminated. On the other hand, it could be an opportunity for the student to learn a deep lesson regarding the ownership of intellectual property and the obligations of collaboration.

Responsible Conduct of Research and Participation

Scientists and educators have a duty to obey rules and regulations regarding the responsible conduct of research and ethical participation in the activities of their department, laboratory, or company. For publicly supported research, this means adhering to both institutional and federal rules (e. g. OMB Circular A21 for federally supported research at universities) in making expenditures, and acting in a manner that recognizes the importance of spending taxpayers' money wisely, and with as little waste as possible.

Research support is not an entitlement. In the course of working within a company, a national laboratory, or a university department, there are also issues of ethics and fairness, which should govern day-to-day behavior. In all of these arenas, individuals may be confronted with difficult choices. This is especially important in the context of personnel decisions.

As a class, or as an assignment, have students create a list of items that would fall under responsible conduct of research and participation.

Responsible Conduct of Research and Participation Case Study: Conflict of Interest

You are in a subfield of physics that is financially strapped. You are asked to do a technical review of an experiment, which is not directly the same as one you have proposed but if it is not funded, yours is likely to be (or vice-versa).

Questions

- Should you refuse to participate in the review?
- Why or why not?

Discussions may refer to previous conflicts of interest discussed; for example, Publication Practices Case Study: Conflict of Interest in Refereeing (page 46).

Conflict of Interest Discussion

In many situations, it is impossible to completely avoid any conflict of interest. This is particularly true in smaller subfields, where a limited number of people compete for the same pot of money. Funding agencies recognize that such conflicts are likely to exist.

Of primary importance is the disclosure of both actual and possibly perceived conflicts of interest. In this situation, it would be advisable to disclose to the party requesting the review that you may have a competing interest. It is then up to them to decide whether they still want your review, and if so, how to factor it in to their decision-making process.

Responsible Conduct of Research and Participation Case Study: Financial Responsibility

A researcher's expenses are paid by a contract or grant to attend a conference at a distant location. The individual buys an economy class airline ticket, and saves money in that fashion. He or she is also able to find a relatively inexpensive hotel room, and inexpensive restaurants for meals. On returning, the researcher learns that there is the possibility of charging a fixed per diem that is substantially larger than the actual expenses, and pocketing the difference. This is not a situation in which taking the per diem is the only option.

Questions

- Where should one go to find out what the expectations are?
- Some institutions may have explicit policies dealing with this. That is, the option may originate with the university but not be allowed by the granting agency, or vice versa. If it is optional, should the individual take the per diem and pocket the difference, or should he or she report only those expenses actually incurred?
- What should a group leader or department head do to avoid uncertainty?

Undergraduate and graduate students often feel the financial pressures of trying to make ends meet. Emphasize the importance of honesty in science, and ask how that carries over to situations like these.

Responsible Conduct of Research and Participation Case Study: Interface with the Public: Signing a Petition

In the 1980's, President Ronald Reagan proposed building a missile defense system that would provide a defensive shield for the United States. The Strategic Defense Initiative was heavily funded, opening up research opportunities for physicists, engineers, and computer scientists among others. In 1985, a petition circulated among many physics departments in the U.S. It read, in part:

> We, the undersigned science and engineering faculty, believe that the Strategic Defense Initiative (SDI) program (commonly known as Star Wars) is ill conceived and dangerous….
>
> Participation in SDI by individual researchers would lend their institution's name to a program of dubious scientific validity, and give legitimacy to this program at a time when the involvement of prestigious research institutions is being sought to increase Congressional support….
>
> Accordingly, as working scientists and engineers, we pledge neither to solicit nor accept SDI funds, and encourage others to join us in this refusal. We hope together to persuade the public and Congress not to support this deeply misguided and dangerous program.

Questions

- Setting aside for a moment the specifics of SDI, under what circumstances is it appropriate to sign a petition such as this?
- What does signing a petition say to society?

It is important not to discourage people from participation in what they feel is their responsibility to society. At the same time it is important for students to consider the issues raised in the discussion that follows. The discussion below is included in the student edition.

Interface with the Public: Signing a Petition Discussion

It is important to recognize that a key motivation for this petition is communication to Congress and the general public by scientists and engineers of their stand on an issue. Had the point been merely to refuse SDI funding, that goal could have been accomplished in silence. Signing a petition such as this then raises ethical issues associated with how physicists communicate to others outside their community.

How will signatures on this petition be interpreted? Will they be interpreted as a statement of a political sentiment by a group of professionals, or will they be interpreted as a statement of professional opinion on an issue of political significance? In the latter case, does signing the petition imply you have a certain level of knowledge and expertise in the area? To what extent is it sufficient to rely on the knowledge and expertise of others before deciding to sign this petition? At the same time, if you do believe that you are aware of reliable, relevant information in a debate over an issue of this importance, arguably you have an obligation to actively seek to share that information with others.

It is also worth considering the issue of trust. Complex societies function in part based on the trust we have for people in their area of expertise. Physicists can continue to have a positive impact on society and continue to receive support from society, provided they maintain the trust of society. One aspect of maintaining this trust is making it clear when a statement is being made based primarily on scientific information about which one has some knowledge, and when a statement is being made based on political considerations.

In the case study provided above, insufficient information has been provided in order to judge whether there is a scientific basis on which to sign the petition. More information is required. That, in fact, illustrates the point: one should not express an opinion that might be interpreted as an "expert opinion" without having acquired sufficient knowledge about the technical issues.

A second issue presented by this case study relates to the promise not to solicit a particular form of funding. Suppose you have kept up with the technical issues raised by the petition, and you do feel sufficiently knowledgeable to sign it. If you are presently in a job situation that would not ordinarily give rise to your pursuing such funding, is it reasonable or is it misleading to sign the petition? For instance, if you are a beginning graduate student whose research is funded by the National Science Foundation through a grant held by your thesis advisor, there may be little need for you to apply for funding in the next few years. Is it misleading to sign a petition foreswearing the pursuit of SDI funds when you had no intention of pursuing any funding anyway?

Responsible Conduct of Research and Participation Case Study: Research Management

Many universities have rules about uses of research funding, research involving live subjects, and other areas with ethical content. In order to ensure that faculty are familiar with these rules, they are required to complete a set of online tests. At a faculty meeting, one faculty member complained about the time the certification took, and volunteered to give the test answers to any other faculty member who had not already taken the certification exams.

Questions

- What should the meeting chair have done?
- If you were a faculty member at this meeting, what would you have done?
- Are online certification tests a good way to inform faculty about all of the research rules?
- What is the difference between this faculty member's behavior and an undergraduate who gets the answers to a test in advance and provides them to his friends?

Have the class role play both the original scenario and their responses to the questions below.

Responsible Conduct of Research and Participation Case Study: What Is Appropriate in Tenure Review?

You are in a group of faculty considering a person for tenure.

Question

In setting criteria and standards, would it be appropriate to demand criteria that you, yourself, would not satisfy?

Suggested assignment:

You are on a student advisory board to determine which applicants to the department (or research group) should be allowed to enter as fellow students in the department (or research group).

Appendix A

APS GUIDELINES FOR PROFESSIONAL CONDUCT

(Adopted by Council on November 10, 2002)
(Original version adopted by Council on 3 November 1991.)

The Constitution of the American Physical Society states that the objective of the Society shall be the advancement and diffusion of the knowledge of physics. It is the purpose of this statement to advance that objective by presenting ethical guidelines for Society members.

Each physicist is a citizen of the community of science. Each shares responsibility for the welfare of this community. Science is best advanced when there is mutual trust, based upon honest behavior, throughout the community. Acts of deception, or any other acts that deliberately compromise the advancement of science, are unacceptable. Honesty must be regarded as the cornerstone of ethics in science. Professional integrity in the formulation, conduct, and reporting of physics activities reflects not only on the reputations of individual physicists and their organizations, but also on the image and credibility of the physics profession as perceived by scientific colleagues, government and the public. It is important that the tradition of ethical behavior be carefully maintained and transmitted with enthusiasm to future generations.

The following are the minimal standards of ethical behavior relating to several critical aspects of the physics profession. Physicists have an individual and a collective responsibility to ensure that there is no compromise with these guidelines.

Research Results

The results of research should be recorded and maintained in a form that allows analysis and review. Research data should be immediately available to scientific collaborators. Following publication, the data should be retained for a reasonable period in order to be available promptly and completely to responsible scientists. Exceptions may be appropriate in certain circumstances in order to preserve privacy, to assure patent protection, or for similar reasons.

Fabrication of data or selective reporting of data with the intent to mislead or deceive is an egregious departure from the expected norms of scientific conduct, as is the theft of data or research results from others.

Publication and Authorship Practices

Authorship should be limited to those who have made a significant contribution to the concept, design, execution or interpretation of the research study. All those who have made significant contributions should be offered the opportunity to be listed as authors. Other individuals who have contributed to the study should be acknowledged, but not identified as authors. The sources of financial support for the project should be disclosed.

Plagiarism constitutes unethical scientific behavior and is never acceptable. Proper acknowledgement of the work of others used in a research project must always be given. Further, it is the obligation of each author to provide prompt retractions or corrections of errors in published works.

Peer Review

Peer review provides advice concerning research proposals, the publication of research results and career advancement of colleagues. It is an essential component of the scientific process.

Peer review can serve its intended function only if the members of the scientific community are prepared to provide thorough, fair and objective evaluations based on requisite expertise. Although peer review can be difficult and time-consuming, scientists have an obligation to participate in the process.

Privileged information or ideas that are obtained through peer review must be kept confidential and not used for competitive gain.

Reviewers should disclose conflicts of interest resulting from direct competitive, collaborative, or other relationships with any of the authors, and avoid cases in which such conflicts preclude an objective evaluation.

Conflict of Interest

There are many professional activities of physicists that have the potential for a conflict of interest. Any professional relationship or action that may result in a conflict of interest must be fully disclosed. When objectivity and effectiveness cannot be maintained, the activity should be avoided or discontinued.

It should be recognized that honest error is an integral part of the scientific enterprise. It is not unethical to be wrong, provided that errors are promptly acknowledged and corrected when they are detected.

Supplementary Guidelines on Responsibilities of Coauthors and Collaborators

(Adopted by Council on November 10, 2002)
*(This statement includes language from the "**Report of the Investigation Committee on the Possibility of Scientific Misconduct in the Work of Hendrick Schön and Coauthors**," M. Beasley, S. Datta, H. Kogelnik, H. Kroemer, D. Monroe, September 25, 2002 - internal Bell Laboratories report, Bell Labs, Lucent Technologies. The language is used with the permission of Bell Labs.)*

All collaborators share some degree of responsibility for any paper they coauthor. Some coauthors have responsibility for the entire paper as an accurate, verifiable, report of the research. These include, for example, coauthors who are accountable for the integrity of the critical data reported in the paper, carry out the analysis, write the manuscript, present major findings at conferences, or provide scientific leadership for junior colleagues.

Coauthors who make specific, limited, contributions to a paper are responsible for them, but may have only limited responsibility for other results. While not all coauthors may be familiar with all aspects of the research presented in their paper, all collaborations should have in place an appropriate process for reviewing and ensuring the accuracy and validity of the reported results, and all coauthors should be aware of this process.

Every coauthor should have the opportunity to review the manuscript before its submission. All coauthors have an obligation to provide prompt retractions or correction of errors in published works. Any individual unwilling or unable to accept appropriate responsibility for a paper should not be a coauthor.

Supplementary Guideline on Research Results

(Adopted by Council on 10 November 2002)

Collaborations are expected to have a process to archive and verify the research record; to facilitate internal communication and allow all authors to be fully aware of the entire work; and respond to questions concerning the joint work and enable other responsible scientists to share the data. All members of a collaboration should be familiar with, and understand, the process.

Supplementary Guideline on References in Publications

(Adopted by Council, 30 April 2004)

Authors have an obligation to their colleagues and the physics community to include a set of references that communicates the precedents, sources, and context of the reported work. Proper referencing gives credit to those whose research has informed or led to the work in question, helps to avoid duplication of effort, and increases the value of a paper by guiding the reader to related materials. It is the responsibility of authors to have surveyed prior work in the area and to include relevant references.

Proper and complete referencing is an essential part of any physics research publication. Deliberate omission of a pertinent author or reference is unethical and unacceptable.

Appendix B

APS POLICIES FOR HANDLING ALLEGATIONS OF RESEARCH MISCONDUCT

(Adopted by Council on November 10, 2002)

Research misconduct, defined as fabrication, falsification or plagiarism in proposing, performing, or reviewing research, or in reporting research results, is an egregious departure from the expected norms of scientific conduct. It can lead significant numbers of other scientists along fruitless paths. It diminishes the vital trust that scientists have in each other. It undermines public confidence in science. It is imperative, therefore, that the institutions responsible for the funding and performance of scientific research, as well as the relevant professional societies, take appropriate steps to discourage such conduct and have policies and procedures in place to deal with allegations of misconduct.

The Council of the American Physical Society and its Panel on Public Affairs have undertaken a reassessment of the Society's policies and practices relevant to professional ethics. As part of that assessment, the Council has recognized that the Federal Policy on Research Misconduct of December 6, 2000 (see Appendix C) has become a cornerstone of efforts in the United States to maintain the integrity of the scientific literature. The Policy, which applies to all Federal agencies that fund research, defines research misconduct, delineates responsibilities of the involved organizations and provides procedural guidelines for dealing with allegations of misconduct in federally funded research. It has been used effectively by both university-managed federal laboratories and private corporations in dealing with accusations of scientific misconduct.

Implementation of this policy by all Federal agencies that fund research - and by all U.S. institutions performing physics research - will be a significant advance in ensuring the proper treatment of allegations of research misconduct.

The Council of the American Physical Society, therefore, urges:

- All Federal agencies to complete and publish their implementation plans, as called for in the Preamble to the attached Federal Policy on Research Misconduct.
- All research institutions that receive Federal research funding to establish implementation plans that are consistent with the attached Federal policy.
- All research institutions that do not receive Federal research funding to develop policies and implementation plans that are consistent with the attached Federal Policy if they have not already done so.

Appendix C

U.S. Federal Policy on Research Misconduct

FEDERAL POLICY ON RESEARCH MISCONDUCT[1]

I. Research[2] Misconduct Defined

Research misconduct is defined as fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results.

- *Fabrication* is making up data or results and recording or reporting them.
- *Falsification* is manipulating research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record.[3]
- *Plagiarism* is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit.
- Research misconduct does not include honest error or differences of opinion.

II. Findings of Research Misconduct

A finding of research misconduct requires that:

- There be a significant departure from accepted practices of the relevant research community; and
- The misconduct be committed intentionally, or knowingly, or recklessly; and
- The allegation be proven by a preponderance of evidence.

III. Responsibilities of Federal Agencies and Research Institutions[4]

Agencies and research institutions are partners who share responsibility for the research process. Federal agencies have ultimate oversight authority for Federally funded research, but research institutions bear primary responsibility for prevention and detection of research misconduct and for the inquiry, investigation, and adjudication of research misconduct alleged to have occurred in association with their own institution.

- Agency Policies and Procedures. Agency policies and procedures with regard to intramural as well as extramural programs must conform to the policy described in this document.
- Agency Referral to Research Institution. In most cases, agencies will rely on the researcher's home institution to make the initial response to allegations of research misconduct. Agencies will usually refer allegations of research misconduct made directly to them to the appropriate research institution. However, at any time, the Federal agency may proceed with its own inquiry or investigation. Circumstances in which agencies may elect not to defer to the research institution include, but are not limited to, the following: the agency determines the institution is not prepared to handle the allegation in a manner consistent with this policy; agency involvement is needed to protect the public interest, including public health and safety; the allegation involves an entity of sufficiently small size (or an individual) that it cannot reasonably conduct the investigation itself.
- Multiple Phases of the Response to an Allegation of Research Misconduct. A response to an allegation of research misconduct will usually consist of several phases, including: (1) an inquiry -- the assessment of whether the allegation has substance and if an investigation is warranted; (2) an investigation -- the formal

development of a factual record, and the examination of that record leading to dismissal of the case or to a recommendation for a finding of research misconduct or other appropriate remedies; (3) adjudication -- during which recommendations are reviewed and appropriate corrective actions determined.

- Agency Follow-up to Institutional Action. After reviewing the record of the investigation, the institution?s recommendations to the institution's adjudicating official, and any corrective actions taken by the research institution, the agency will take additional oversight or investigative steps if necessary. Upon completion of its review, the agency will take appropriate administrative action in accordance with applicable laws, regulations, or policies. When the agency has made a final determination, it will notify the subject of the allegation of the outcome and inform the institution regarding its disposition of the case. The agency finding of research misconduct and agency administrative actions can be appealed pursuant to the agency's applicable procedures.
- Separation of Phases. Adjudication is separated organizationally from inquiry and investigation. Likewise, appeals are separated organizationally from inquiry and investigation.
- Institutional Notification of the Agency. Research institutions will notify the funding agency (or agencies in some cases) of an allegation of research misconduct if (1) the allegation involves Federally funded research (or an application for Federal funding) and meets the Federal definition of research misconduct given above, and (2) if the institution's inquiry into the allegation determines there is sufficient evidence to proceed to an investigation. When an investigation is complete, the research institution will forward to the agency a copy of the evidentiary record, the investigative report, recommendations made to the institution's adjudicating official, and the subject's written response to the recommendations (if any). When a research institution completes the adjudication phase, it will forward the adjudicating official's decision and notify the agency of any corrective actions taken or planned.
- Other Reasons to Notify the Agency. At any time during an inquiry or investigation, the institution will immediately notify the Federal agency if public health or safety is at risk; if agency resources or interests are threatened; if research activities should be suspended; if there is reasonable indication of possible violations of civil or criminal law; if Federal action is required to protect the interests of those involved in the investigation; if the research institution believes the inquiry or investigation may be made public prematurely so that appropriate steps can be taken to safeguard evidence and protect the rights of those involved; or if the research community or public should be informed.
- When More Than One Agency is Involved. A lead agency should be designated to coordinate responses to allegations of research misconduct when more than one agency is involved in funding activities relevant to the allegation. Each agency may implement administrative actions in accordance with applicable laws, regulations, policies, or contractual procedures.

IV. Guidelines for Fair and Timely Procedures

The following guidelines are provided to assist agencies and research institutions in developing fair and timely procedures for responding to allegations of research misconduct. They are designed to provide safeguards for subjects of allegations as well as for informants. Fair and timely procedures include the following:

- Safeguards for Informants. Safeguards for informants give individuals the confidence that they can bring allegations of research misconduct made in good faith to the attention of appropriate authorities or serve as informants to an inquiry or an investigation without suffering retribution. Safeguards include protection against retaliation for informants who make good faith allegations, fair and objective procedures for the examination and resolution of allegations of research misconduct, and diligence in

protecting the positions and reputations of those persons who make allegations of research misconduct in good faith.

- Safeguards for Subjects of Allegations. Safeguards for subjects give individuals the confidence that their rights are protected and that the mere filing of an allegation of research misconduct against them will not bring their research to a halt or be the basis for other disciplinary or adverse action absent other compelling reasons. Other safeguards include timely written notification of subjects regarding substantive allegations made against them; a description of all such allegations; reasonable access to the data and other evidence supporting the allegations; and the opportunity to respond to allegations, the supporting evidence and the proposed findings of research misconduct (if any).
- Objectivity and Expertise. The selection of individuals to review allegations and conduct investigations who have appropriate expertise and have no unresolved conflicts of interests help to ensure fairness throughout all phases of the process.
- Timeliness. Reasonable time limits for the conduct of the inquiry, investigation, adjudication, and appeal phases (if any), with allowances for extensions where appropriate, provide confidence that the process will be well managed.
- Confidentiality During the Inquiry, Investigation, and Decision-Making Processes. To the extent possible consistent with a fair and thorough investigation and as allowed by law, knowledge about the identity of subjects and informants is limited to those who need to know. Records maintained by the agency during the course of responding to an allegation of research misconduct are exempt from disclosure under the Freedom of Information Act to the extent permitted by law and regulation.

V. Agency Administrative Actions

- Seriousness of the Misconduct. In deciding what administrative actions are appropriate, the agency should consider the seriousness of the misconduct, including, but not limited to, the degree to which the misconduct was knowing, intentional, or reckless; was an isolated event or part of a pattern; or had significant impact on the research record, research subjects, other researchers, institutions, or the public welfare.
- Possible Administrative Actions. Administrative actions available include, but are not limited to, appropriate steps to correct the research record; letters of reprimand; the imposition of special certification or assurance requirements to ensure compliance with applicable regulations or terms of an award; suspension or termination of an active award; or suspension and debarment in accordance with applicable government-wide rules on suspension and debarment. In the event of suspension or debarment, the information is made publicly available through the List of Parties Excluded from Federal Procurement and Nonprocurement Programs maintained by the U.S. General Services Administration. With respect to administrative actions imposed upon government employees, the agencies must comply with all relevant federal personnel policies and laws.
- In Case of Criminal or Civil Fraud Violations. If the funding agency believes that criminal or civil fraud violations may have occurred, the agency shall promptly refer the matter to the Department of Justice, the Inspector General for the agency, or other appropriate investigative body.

VI. Roles of Other Organizations

This Federal policy does not limit the authority of research institutions, or other entities, to promulgate additional research misconduct policies or guidelines or more specific ethical guidance.

[1] *No rights, privileges, benefits or obligations are created or abridged by issuance of this policy alone. The creation or abridgment of rights, privileges, benefits or obligations, if any, shall occur only upon implementation of this policy by the Federal agencies.*
[2] *Research, as used herein, includes all basic, applied, and demonstration research in all fields of science, engineering, and mathematics. This includes, but is not limited to, research in economics, education, linguistics, medicine, psychology, social sciences, statistics, and research involving human subjects or animals.*

[3] *The research record is the record of data or results that embody the facts resulting from scientific inquiry, and includes, but is not limited to, research proposals, laboratory records, both physical and electronic, progress reports, abstracts, theses, oral presentations, internal reports, and journal articles.*

[4] *The term "research institutions" is defined to include all organizations using Federal funds for research, including, for example, colleges and universities, intramural Federal research laboratories, Federally funded research and development centers, national user facilities, industrial laboratories, or other research institutes. Independent researchers and small research institutions are covered by this policy.*

Resources

Links on these pages are current as of January 2011. A list of online ethics resources is also available on the APS website at www.aps.org/programs/education/ethics

Federal Government Resources

Responsible Conduct of Research, National Science Foundation. Resources on implementing NSF's requirement to provide ethics training and oversight to researchers supported by NSF grants. http://www.nsf.gov/bfa/dias/policy/rcr.jsp

Grant General Conditions, National Science Foundation. Article Subject 18 of GCG (January 4, 2010) describes the responsible conduct of research requirements. www.nsf.gov/pubs/gc1/jan10.pdf

Office of Inspector General, National Science Foundation. Includes many links to conferences and studies, as well as briefings for administrators and students, and case studies (located at the bottom of the website). www.nsf.gov/oig/pubs.jsp#outreach

Office of Research Integrity, U.S. Department of Health and Human Services. Includes links to conferences on ethics. http://ori.dhhs.gov

National Academies Resources

"On Being a Scientist: Responsible Conduct in Research", National Academy of Sciences. This book can be viewed online at www.nap.edu/openbook.php?record_id=4917

Online Ethics Center for Engineering and Research, National Academy of Engineering. Contains course work, scenarios, and links to a number of ethics websites from various professional research societies. www.onlineethics.org

Ethics Education and Scientific and Engineering Research, National Academy of Engineering. Published summary of workshop held in 2009. Book is available for purchase or free online at books.nap.edu/catalog.php?record_id=12695

Professional Society Resources

Ethics and Values Statements, American Physical Society. APS policy statements on-line. www.aps.org/policy/statements

"Ethics and the Welfare of the Physics Profession", American Physical Society.
Response to a 2004 survey by the APS Task Force on Ethics Education. Full citation of article is K. Kirby, F.A. Houle, "Ethics and the Welfare of the Physics Profession," *Physics Today* **57** (11) 42-49, 2004. http://dx.doi.org/10.1063/1.1839376
Workshop on Scientific Misconduct and the Role of Physics Journals in its Investigation and Prevention,

International Union of Pure and Applied Physics. Proceedings from a 2003 workshop and online resources provided by IUPAP. www.iupap.org/wg/communications/ethics

Comparing Research Ethics. A collection of various professional societies' ethics statements. www.dmoz.org/Science/Science_in_Society/Research_Ethics/Guidelines_and_Codes

Sigma Xi: Ethics and Research. The ethics page of Sigma XI, the Scientific Research Society. The "Publications" link on the left leads to several publications on research ethics that can be purchased 1999 document above can be downloaded online through a link on this page. www.sigmaxi.org/programs/ethics

University Resources

Responsible Conduct in Research Instruction, Eastern Michigan University. Contains multiple ethics topics (modules) and scenarios. The course can be taken online or incorporated into an ethics class. Downloadable files are available. A certificate of completion is provided after completing each module of the online course. www.rcr.emich.edu

Ethical Issues in Physics Informational Site, Eastern Michigan University. Contains the proceedings of two ethical workshops and other resources. http://people.emich.edu/jthomsen/Ethics/EIPHome.htm

Ethics in Science, Virginia Polytechnic Institute and State University. This site has listings of recent misconduct cases, science ethics resources, and selected essays on ethics in science. www.files.chem.vt.edu/chem-ed/ethics

Scientific Ethics: A Course in the Responsible Conduct of Research, University of California at San Diego. Links to UCSD's scientific ethics course. http://ethics.ucsd.edu/courses/ethics

Teaching Chemical Ethics, Duke University. Article on teaching chemical ethics. http://library.duke.edu/research/subject/guides/chemical-ethics

Research Ethics and Responsibilities. Course at University of Illinois at Urbana-Champaign. http://www.life.illinois.edu/mcb/580/

Professional Ethics and Responsible Conduct of Research, University of Minnesota. Includes brochure. www.grad.umn.edu/Ethics/ethics_brochure.html