Responsible Conduct of Research Lecture Series

The Division of Graduate Studies

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Preventing Misconduct in the Sciences

* What would you do?
* Your Lab Notebook

Presenter:

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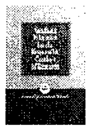
<u>References</u>

"On Being a Scientist"
The National Academy of Science
http://www.nap.edu
"Scientific Misconduct"
(Wikipedia)
"Three Case Studies from Florida State University"
FSU- Graduate Studies
"Laboratory Notebooks Chronicles a Scientist's Progress" Ricki Lewis (The Scientist)
"Proper Maintenance of a Laboratory Notebook"
(Darby and Darby, www.darbylaw.com)
"Laboratory Notebooks"
Stanley Moloy
http://www.life.uiuc.edu/mcb/580/lab-notes.html

February 2008

The Graduate School



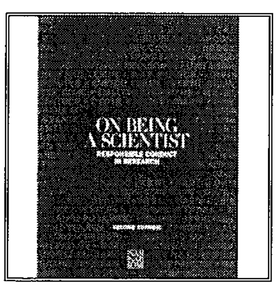
Responsible Conduct of Research Initiatives

The Council of Graduate Schools has a major initiative designed to enhance the training of graduate students in the Responsible Conduct of Research (RCR).

The graduate dean community is committed to achieving the highest standards of integrity in scientific research and recognizes that institutional and governmental policies and procedures for dealing with allegations of misconduct alone are not sufficient to insure the responsible conduct of research. CGS believed that the time has come for an aggressive strategy to educate scientists and those they train about the professional norms and the ethical standards that are central to the responsible conduct of research.

http://www.cgsnet.org/

"On Being a Scientist"



COMMITTEE ON SCIENCE, ENGINEERING, AND PUBLIC POLICY
NATIONAL ACADEMY OF SCIENCES
NATIONAL ACADEMY OF ENGINEERING
INSTITUTE OF MEDICINE

NATIONAL ACADEMY PRESS
Washington, D.C. 1995

http://www.nap.edu/html/obas/

Experimental Techniques and the Treatment of Data

One goal of methods is to facilitate the independent verification of scientific observations. Thus, many experimental techniques-such as statistical tests of significance, double-blind trials, or proper phrasing of questions on surveys-have been designed to minimize the influence of individual bias in research. By adhering to these techniques, researchers produce results that others can more easily reproduce, which promotes the acceptance of those results into the scientific consensus.

Researchers have to be extremely clear, both to themselves and to others, about the methods being used to gather and analyze data. Other scientists will be judging not only the validity of the data but also the validity and accuracy of the methods used to derive those data. The development of new methods can be a controversial process, as scientists seek to determine whether a given method can serve as a reliable source of new information. If someone is not forthcoming about the procedures used to derive a new result, the validation of that result by others will be hampered.

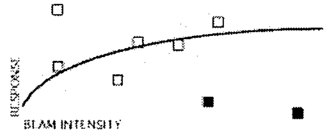
Methods are important in science, but like scientific knowledge itself, they are not infallible. As they evolve over time, better methods supersede less powerful or less acceptable ones. Methods and scientific knowledge thus progress in parallel, with each area of knowledge contributing to the other.

Experimental Techniques and the Treatment of Data

Deborah, a third-year graduate student, and Kathleen, a postdoc, have made a series of measurements on a new experimental semiconductor material using an expensive neutron source at a national laboratory. When they get back to their own laboratory and examine the data, they get the following data points. A newly proposed theory predicts results indicated by the curve.

During the measurements at the national laboratory, Deborah and Kathleen observed that there were power fluctuations they could not control or predict. Furthermore, they discussed their work with another group doing similar experiments, and they knew that the other group had gotten results confirming the theoretical prediction and was writing a manuscript describing their results.

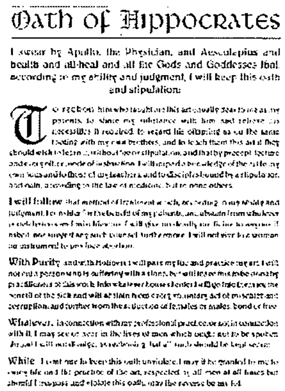
In writing up their own results for publication, Kathleen suggests dropping the two anomalous data points near the abscissa (the solid squares) from the published graph and from a statistical analysis. She proposes that the existence of the data points be mentioned in the paper as possibly due to power fluctuations and being outside the expected standard deviation calculated from the remaining data points. "These two runs," she argues to Deborah, "were obviously wrong."



1. How should the data from the two suspected runs be handled?
2. Should the data be included in tests of statistical significance and why?
3. What other sources of information, in addition to their faculty advisor, can Deborah and Kathleen use to help decide?

http://www.nap.edu/html/obas/contents/experimental.html

Values in Science



Oath of Hippocrates

I swear by Apollo the Physician, and Aesculapius and health and all-heal and all the Gods and Goddesses that, according to my ability and judgment, I will keep this oath and stipulation:

To reckon him who taught me this art equally dear to me as my parents, to share my substance with him and relieve his necessities if required; to regard his offspring as on the same footing with my own brothers, and to teach them this art if they should wish to learn it, without fee or stipulation, and that by precept, lecture and every other mode of instruction I will impart a knowledge of the art to my own sons and to those of my teachers, and to disciples bound by a stipulation and oath, according to the law of medicine, but to none others.

I will follow that method of treatment which, according to my ability and judgment, I consider for the benefit of my patients, and abstain from whatever [illegible]. I will give no deadly medicine to anyone if asked, nor suggest any such counsel; furthermore, I will not give to a woman an instrument to produce abortion.

With Purity and with Holiness I will pass my life and practice my art. I will not cut a person who is suffering with a stone, but will leave this to be done by practitioners of this work. Into whatever houses I enter I will go into them for the benefit of the sick and will abstain from every voluntary act of mischief and corruption; and further from the seduction of females or males, bond or free.

Whatever, in connection with my professional practice, or not in connection with it, I may see or hear in the lives of men which ought not to be spoken abroad, I will not divulge, as reckoning that all such should be kept secret.

While I continue to keep this oath unviolated, may it be granted to me to enjoy life and the practice of the art, respected by all men at all times but should I trespass and violate this oath, may the reverse be my lot.

Scientists bring more than just a toolbox of techniques to their work. Scientist must also make complex decisions about the interpretation of data, about which problems to pursue, and about when to conclude an experiment. They have to decide the best ways to work with others and exchange information. Taken together, these matters of judgment contribute greatly to the craft of science, and the character of a person's individual decisions helps determine that person's scientific style (as well as, on occasion, the impact of that person's work).

The history of science offers a number of episodes in which social or personal beliefs distorted the work of researchers. The field of eugenics used the techniques of science to try to demonstrate the inferiority of certain races. The ideological rejection of Mendelian genetics in the Soviet Union beginning in the 1930s crippled Soviet biology for decades.

The challenge for individual scientists is to acknowledge and try to understand the suppositions and beliefs that lie behind their own work so that they can use that self-knowledge to advance their work. Such self-examination can be informed by study in many areas outside of science, including history, philosophy, sociology, literature, art, religion, and ethics. If narrow specialization and a single-minded focus on a single activity keep a researcher from developing the perspective and fine sense of discrimination needed to apply values in science, that person's work can suffer.

Sample of Cases

Researcher Faces Prison for Fraud in NIH Grant Applications and Papers

Eli Kintisch

A researcher formerly at the University of Vermont College of Medicine has admitted in court documents to falsifying data in 15 federal grant applications and numerous published articles.

MIT Fires Professor Van Parijs for Using Fake Data.

By Kelley Rivoire EDITOR IN CHIEF

Professor of Biology Luk Van Parijs has been dismissed after admitting to fabricating and falsifying research data, MIT announced yesterday.Van Parijs, who came to MIT five years ago and was promoted to associate professor last July, first came under fire in August 2004, when members of his laboratory in the Center for Cancer Research reported allegations of misconduct to MIT. They couldn't find or identify some of the data, said Alice P. Gast, vice president for research and associate provost. Van Parijs could not be reached for comment yesterday.

Japan's Universities Take Action

Dennis Normile TOKYO--Two leading Japanese universities have fired scientists because of questionable publications, and a researcher is reported to have resigned from a third university over alleged mishandling of research funds. Researchers say the unprecedented actions suggest that Japanese institutions are now taking a tougher line on scientific integrity.

Conflicts of Interest

John, a third-year graduate student, is participating in a department-wide seminar where students, postdocs, and faculty members discuss work in progress. An assistant professor prefaces her comments by saying that the work she is about to discuss is sponsored by both a federal grant and a biotechnology firm for which she consults. In the course of the talk John realizes that he has been working on a technique that could make a major contribution to the work being discussed. But his faculty advisor consults for a different, and competing, biotechnology firm.

1. How should John participate in this seminar?
2. What, if anything, should he say to his advisor-and when?
3. What implications does this case raise for the traditional openness and sharing of data, materials, and findings that have characterized modern science?

http://www.nap.edu/html/obas/contents/conflicts.html

"Sharing of Credit"

The principle of fairness and the role of personal recognition within the reward system of science account for the emphasis given to the proper allocation of credit. In the standard scientific paper, credit is explicitly acknowledged in three places: in the list of authors, in the acknowledgments of contributions from others, and in the list of references or citations. Conflicts over proper attribution can arise in any of these places.

Citations serve many purposes in a scientific paper. They acknowledge the work of other scientists, direct the reader toward additional sources of information, acknowledge conflicts with other results, and provide support for the views expressed in the paper. More broadly, citations place a paper within its scientific context, relating it to the present state of scientific knowledge.

Failure to cite the work of others can give rise to more than just hard feelings. Citations are part of the reward system of science. They are connected to funding decisions and to the future careers of researchers. More generally, the misallocation of credit undermines the incentive system for publication.

In addition, scientists who routinely fail to cite the work of others may find themselves excluded from the fellowship of their peers. This consideration is particularly important in one of the more intangible aspects of a scientific career-that of building a reputation. Published papers document a person's approach to science, which is why it is important that they be clear, verifiable, and honest. In addition, a researcher who is open, helpful, and full of ideas becomes known to colleagues and will benefit much more than someone who is secretive or uncooperative.

Some people succeed in science despite their reputations. Many more succeed at least in part because of their reputations.

"Sharing of Credit"

Ben, a third-year graduate student, had been working on a research project that involved an important new experimental technique. For a national meeting in his discipline, Ben wrote an abstract and gave a brief presentation that mentioned the new technique. After his presentation, he was surprised and pleased when Dr. Freeman, a leading researcher from another university, engaged him in an extended conversation. Dr. Freeman asked Ben extensively about the new technique, and Ben described it fully. Ben's own faculty advisor often encouraged his students not to keep secrets from other researchers, and Ben was flattered that Dr. Freeman would be so interested in his work.

Six months later Ben was leafing through a journal when he noticed an article by Dr. Freeman. The article described an experiment that clearly depended on the technique that Ben had developed. He didn't mind; in fact, he was again somewhat flattered that his technique had so strongly influenced Dr. Freeman's work. But when he turned to the citations, expecting to see a reference to his abstract or presentation, his name was nowhere to be found.

1. Does Ben have any way of receiving credit for his work?
2. Should he contact Dr. Freeman in an effort to have his work recognized?
3. Is Ben's faculty advisor mistaken in encouraging his students to be so open about their work?bout the

http://www.nap.edu/html/obas/contents/allocation.html

"Errors in Science"

Scientific results are inherently provisional. Scientists can never prove conclusively that they have described some aspect of the natural or physical world with complete accuracy. In that sense all scientific results must be treated as susceptible to error.

Errors arising from human fallibility also occur in science. Scientists do not have limitless working time or access to unlimited resources. Even the most responsible scientist can make an honest mistake. When such errors are discovered, they should be acknowledged, preferably in the same journal in which the mistaken information was published. Scientists who make such acknowledgments promptly and openly are rarely condemned by colleagues.

Mistakes made through negligent work are treated more harshly. Haste, carelessness, inattention-any of a number of faults can lead to work that does not meet the standards demanded in science. If scientists cut corners for whatever reason, they are placing their reputation, the work of their colleagues, and the public's confidence in science at risk.

Some researchers may feel that the pressures on them are an inducement to haste at the expense of care. For example, they may believe that they have to do substandard work to compile a long list of publications and that this practice is acceptable. Or they may be tempted to publish virtually the same research results in two different places or publish their results in "least publishable units"-papers that are just detailed enough to be published but do not give the full story of the research project described.

Sacrificing quality to such pressures can easily backfire. A lengthy list of publications cannot outweigh a reputation for shoddy research. Scientists with a reputation for publishing a work of dubious quality will generally find that all of their publications are viewed with skepticism by their colleagues. Reflecting the importance of quality, some institutions and federal agencies have recently adopted policies that limit the number of papers that will be considered when an individual is evaluated for appointment, promotion, or funding.

By introducing preventable errors into science, sloppy or negligent research can do great damage-even if the error is eventually uncovered and corrected. Though science is built on the idea of peer validation and acceptance, actual replication is selective. It is not practical (or necessary) to reconstruct all the observations and theoretical constructs that go into an investigation. Researchers have to trust that previous investigators performed the work as reported.

"Publishing"

Paula, a young assistant professor, and two graduate students have been working on a series of related experiments for the past several years. During that time, the experiments have been written up in various posters, abstracts, and meeting presentations. Now it is time to write up the experiments for publication, but the students and Paula must first make an important decision. They could write a single paper with one first author that would describe the experiments in a comprehensive manner, or they could write a series of shorter, less complete papers so that each student could be a first author.

Paula favors the first option, arguing that a single publication in a more visible journal would better suit all of their purposes. Paula's students, on the other hand, strongly suggest that a series of papers be prepared. They argue that one paper encompassing all the results would be too long and complex and might damage their career opportunities because they would not be able to point to a paper on which they were first authors.

1. If the experiments are part of a series, are Paula and her students justified in not publishing them together?

2. If they decided to publish a single paper, how should the listing of authors be handled?

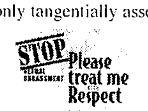
3. If a single paper is published, how can they emphasize to the review committees and funding agencies their various roles and the importance of the paper?

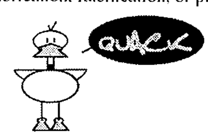
http://www.nap.edu/html/obas/contents/error.html

"Misconduct"

Beyond honest errors and errors caused through negligence are a third category of errors: those that involve deception. Making up data or results (fabrication), changing or misreporting data or results (falsification), and using the ideas or words of another person without giving appropriate credit (plagiarism)- all strike at the heart of the values on which science is based. These acts of scientific misconduct not only undermine progress but the entire set of values on which the scientific enterprise rests. Anyone who engages in any of these practices is putting his or her scientific career at risk. Even infractions that may seem minor at the time can end up being severely punished.

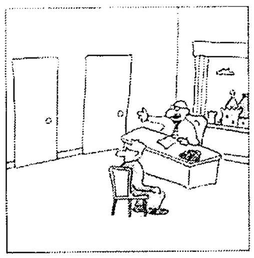
Within the scientific community, the effects of misconduct-in terms of lost time, forfeited recognition to others, and feelings of personal betrayal-can be devastating. Individuals, institutions, and even entire research fields can suffer grievous setbacks from instances of fabrication, falsification, or plagiarism even if they are only tangentially associated with the case.





Another category of behaviors-including sexual or other forms of harassment, misuse of funds, gross negligence in a person's professional activities, tampering with the experiments of others or with instrumentation, and violations of government research regulations-are not necessarily associated with scientific conduct. Institutions need to discourage and respond to such behaviors. But these behaviors are subject to generally applicable legal and social penalties and should be dealt with using the same procedures that would be applied to anyone.

Motivation to commit scientific misconduct



"Behind one door is tenure - behind the other is flipping burgers at McDonald's."

1. Career Pressure: "Publish or perish"
2. Believing that one "knows the right answer"
3. The ability to get away with it.

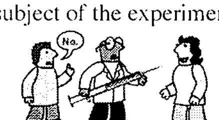
"Forms of Scientific Misconduct"

•**Fabrication** – the publication of deliberately false or misleading research

•**Plagiarism** – the act of taking credit (or attempting to take credit) for the work of another

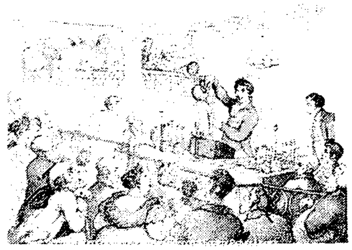
•**Multiple Publication** of the same content with different titles and/or in different journals is sometimes also considered as misconduct

•the violation of **ethical standards** regarding human and animal experiments – such as the standard that a human subject of the experiment must give informed consent to the experiment.



•**Ghostwriting**– the phenomenon where someone other than the named author(s) makes a major contribution. Typically, this is done to mask contributions from drug companies. It incorporates plagiarism and has an additional element of financial fraud.

"The Scientist in Society"



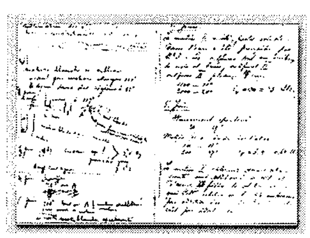
weekendstubble.blogspot.com

Scientists have responsibilities to society. Even scientists conducting the most fundamental research need to be aware that their work can ultimately have a great impact on society. Construction of the atomic bomb and the development of recombinant DNA-events that grew out of basic research on the nucleus of the atom and investigations of certain bacterial enzymes, respectively-are two examples of how seemingly arcane areas of science can have tremendous societal consequences.

The occurrence and consequences of discoveries in basic research are virtually impossible to foresee. Nevertheless, the scientific community must recognize the potential for such discoveries and be prepared to address the questions that they raise. If scientists do find that their discoveries have implications for some important aspect of public affairs, they have a responsibility to call attention to the public issues involved. They might set up a suitable public forum involving experts with different perspectives on the issue at hand. They could then seek to develop a consensus of informed judgment that can be disseminated to the public.

A good example is the response of biologists to the development of recombinant DNA technologies-first calling for a temporary moratorium on the research and then helping to set up a regulatory mechanism to ensure its safety.

"Your Protection - Your Laboratory Notebook"



http://www.aip.org/history/curie/images/photos/notebook-matte.jpg

Keeping a thorough lab notebook is an essential part of scientific research. Your notebook should be legible and thorough enough for someone else to read and understand exactly what you did and why you did it. All protocols and results should be kept in your notebook -- not filed in folders or on your desk. Carefully kept records will be useful for future research and publications, and will minimize problems that may be encountered if any questions arise about your results. The following rules are designed to ensure an accurate and detailed record of your laboratory results.

Please send any comments, suggestions or questions to: gary@life.uiuc.edu
http://www.life.uiuc.edu/mcb/580/lab-notes.html

"Your Protection - Your Laboratory Notebook"

1. Title and number each notebook for easy reference.
2. Include a running Table of Contents so that experimental results can be looked up quickly and easily. Update the Table of Contents each time you begin a new experiment.
3. Write your name at the top of each page. Date each page or entry.
4. Each experiment should include the following sections:

   Purpose. Begin with a short explanation of why you did the experiment.
   Protocol. Include a detailed description of what you actually did. Provide sufficient detail so someone could repeat the experiment exactly the way you did it. Do not count on your memory **Results.** Include the actual raw data in your notebook as well as any plots or calculations. Show any equations used for your calculations.
   Discussion. Include a brief summary of the conclusions. Did the controls work? What do the results mean?

5. Errors should be crossed out with a single line so they remain readable. Do not erase or scratch out errors or tear pages out of your notebook. When an error is made, include a comment on what went wrong and whether the experiment was repeated. This will allow you to figure out what actually happened even a long time after you did the experiment.

6. Tape any attachments (e.g., photographs and print-outs) directly to the notebook. All attachments should include the date and details about how they were obtained.

Please send any comments, suggestions or questions to: gary@life.uiuc.edu
http://www.life.uiuc.edu/mcb/580/lab-notes.html

(From the Office of Professional Training, American Chemical Society)

Abstract

The abstract should, in the briefest terms possible, describe the topic, the scope, the principal findings, and the conclusions. It should be written last to reflect accurately the content of the report. The length of abstracts vary but seldom exceed 200 words.

A primary objective of an abstract is to communicate to the reader the essence of the paper. The reader will then be the judge of whether to read the full report or not. Were the report to appear in the primary literature, the abstract would serve as a key source of indexing terms and key words to be used in information retrieval.

Introduction

A good introduction is a clear statement of the problem or project and why you are studying it. This information should be contained in the first few sentences. On the basis of your answer to the question of what the readers already know, give a concise background of the problem and the significance, scope, and limits of your work. Outline what has been done before by citing truly pertinent literature, but do not include a general survey of semirelevant literature. State how your work differs from work previously published or state how it is related. Demonstrate the continuity from the previous work to yours.

Experimental Sections In research reports, this section can also be called "Experimental Methods, "Experimental Section", or "Materials and Methods. For experimental work, give enough detail about your materials and methods so that other experienced workers could repeat your work and obtain comparable results. When using a standard method, reference the appropriate literature and give only the details needed. Identify the materials you used, and give information on the degree and criteria for purity, but do not reference standard laboratory reagents. Give the chemical names of all compounds and the chemical formulas of compounds that are new or uncommon. Describe your apparatus only if it is not standard and not commercially available, giving a company name and model number in parentheses is adequate and nondistracting. Avoid using trademarks and brand names of equipment and reagents

Results Summarize the data collected and the statistical treatment of them. Include only relevant data, but give sufficient detail to justify your conclusions. Use equations, figures, and tables only where necessary for clarity and conciseness.

Discussion & Conclusions When discussing your results, be objective. Point out the features and limitations of the work, and interpret and compare your results. Relate your specific results to your original purpose in undertaking the project: Have you resolved the problem? What exactly have you contributed? Briefly state the logical implications of your results. Suggest further study or applications if warranted. If you have already presented your conclusions in your "Discussion" section, you do not need a separate section for them. If you do have a separate "Conclusions" section, do not repeat discussion points or include irrelevant material. Your conclusions should be based on the evidence presented.

REFERENCES

❑ Journals:
for example: Huffman, J. C; Lewis, L. N.; Caulton, K G. *Inorg. Chem..*, **1980,** 19, 2755.
❑ Books: In publishers' names, delete words such as "Company","Inc", "Publisher"
for example: Chum, H L.; Baizer, M. M. *The Electrochemistry of Biomass and Derived Materials*; ACS Monograph 183; American Chemical Society Washington, DC, 1985; pp 134-157.