

## Ethics for Young Scientists and Engineers

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*Each physicist is a citizen of  
the community of science.  
Each shares responsibility  
for the welfare of this  
community.*

—Statement by the APS

<http://www.aps.org/statements/02.2.html>

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With thanks to David Hertzog, Lance Cooper, and  
Alan Nathan, who contributed ideas and insights



You are now “scientists.”

Science requires its practitioners to be:

Honest—do not fabricate, misrepresent, manipulate, or destroy data.

Careful—apply rigorous standards.

Skeptical—don’t want to believe so much in some result that you lose your objectivity and critical thinking.

Open—share data, methods, theories, equipment; allow others to see your work; be open to criticism.

Generous—give credit to others; do not plagiarize others’ work; help others.

Socially responsible—anticipate the consequences of research; prevent harm to the public and promote social welfare.

## Scientific progress depends on ...

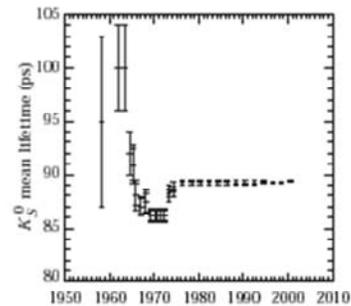
**Truthfulness and full disclosure**

**Accurate and complete record-keeping**

**Free and open exchange of data  
and interpretations**

**Skepticism**

*...but honest error  
is inevitable*



Experimental measurement of the mean lifetime of the kaon, in ps, from 1950 to 2000.

Science, if it is allowed to function as it should, is self correcting. That's why honesty and openness are essential.

Sometimes there's a thin line between honest error and misconduct, just as there is a line between being bold and being reckless. Ethical issues are often decided "on the margins."

**Everyone\* recognizes that deliberate dishonesty is wrong**

**Forged or fabricated data**

**Falsified or invented results**

**Plagiarism**

**Piracy**

**Hoaxes**

**\*Well, almost everyone...**

J. H. Schön, et al., "Ambipolar Pentacene Field-Effect Transistors and Inverters," *Science* 287, 1022 (2000).

J. H. Schön, et al., "A Superconducting Field Effect Switch," *Science* 288, 656 (2000).

In May 2002, a Bell Labs postdoc, Hendrik Schön, was accused of fabricating, manipulating, and destroying data from a number of experiments that had been published in leading scientific journals, including *PRL*, *Science*, and *Nature*. The scandal shook physics to its foundations.

The Schön case followed shortly after Victor Ninov was fired from LBL for fraud after analysis showed that he had fabricated data used to claim the creation of Element 118, and may have altered original data involved in the discovery of Elements 111 and 112. That Ninov case did not create the widespread consternation that the Schön case did, because it was believed to be the misconduct of one misguided individual. But the Schön episode involved so many co-authors, so many prestigious journals, so many reviewers, and had gone on for so long that it was much more shocking.

The aftermath: In 2004, the University of Konstanz revoked Schön's PhD based on a state law that allows degrees to be revoked if the degree holder is found to be "unworthy." Schön sued the university, and in 2010, a court ruled in his favor. The University appealed, and in September 2011, the Administrative Court of Baden-Württemberg in Mannheim ruled that the University was correct in revoking Schön's degree. The German Federal Administrative Court (equivalent to the US Supreme court) upheld the state court's decision on 13 July 2015.

In all, between 31 Oct 2002 and 2 May 2003, *Science* withdrew 9 Schön papers, *PRL* withdrew 6 papers, *Appl. Phys. Lett.* withdrew 4 papers, *Adv. Materials* withdrew 2 papers, and *Nature* withdrew 7 papers. Retraction notices by *Appl. Phys. Lett.* raised concerns about an additional 7 papers by Schön, and *Adv. Materials* issued a retraction notice about an additional Schön paper, in addition to the ones that were formally withdrawn.

For more on the Schön subject: <http://nanoscale.blogspot.com/2007/01/internet-memory-hole-and-jan-hendrik.html>. Do you agree with Professor Natelson? Does Alcatel-Lucent have any obligation to keep the Beasley Commission Report posted publicly?

## Physics was rocked to its foundations in 2002 when one of its brightest young stars...



**INNOVATORS  
UNDER 35**

2002



**Jan Hendrik Schön, 31**

**Nanotechnologies**

Lucent Technologies Bell Labs

Hendrik Schön is reinventing the transistor at the place it was born. He and his Bell Labs coworkers have produced single-molecule transistors whose electrical performance is comparable to that of today's best silicon devices but which are hundreds of times smaller.

Making such molecular transistors, which could lead to ultrafast, ultras-small computers, has been a goal of researchers for years; Schön's clever design established Bell Labs as a leader in the race. But Schön is not interested in simply reinventing the transistor. He wants to change the very materials that form microelectronics, replacing inorganic semiconductors with organic molecules. Schön has made an organic high-temperature superconductor, renewing hopes that superconductors could have widespread electronic applications. He also helped devise the first electrically driven organic laser, which could mean cheaper optoelectronic devices. The soft-spoken Schön recalls being "very surprised" by how well his molecular transistors worked. But it won't be a surprise if Schön helps transform microelectronics.

I

The screenshot shows a webpage from physicsworld.com. At the top, a large blue headline reads: "...was accused of fabricating results in >30 papers, including *Nature* and *Science*". Below this is a red horizontal line, followed by the text "IOP Physics World - the member magazine of the Institute of Physics". The website logo "physicsworld.com" is displayed in red and grey. A navigation bar contains links for Home, News, Blog, Multimedia, In depth, and Events. On the left, a "News archive" sidebar lists years from 2015 down to 2002, with months for the year 2002. The main content area features the article title "Bell Labs physicist fired for misconduct" dated "Sep 25, 2002". The article text states: "A physicist at Bell Labs has been sacked for falsifying and fabricating data in a series of high-profile papers on superconductivity and molecular electronics. Jan Hendrik Schön was fired today after an investigation committee found him guilty of 'scientific misconduct' on 16 out of 24 charges. All of his co-authors, who had contributed to the experiments and appeared on several of the papers, have been cleared of any misconduct." A second paragraph explains that Schön was first suspected of scientific misconduct earlier in the year when physicists noticed similarities between graphs in two papers published in *Science* and one in *Nature*. The article concludes by mentioning the investigation committee chaired by Malcolm Beasley of Stanford University, which questioned Schön and his three principal co-authors: Zhenan Bao, Bertram Batlogg, and Christian Kloc.

## After 9 years of rulings, appeals, and new rulings, the German Supreme Court finally revoked Schön's PhD in 2011



News > Europe > Jan Hendrik Schön Loses His Ph.D.

### SCIENCEINSIDER

Breaking news and analysis from the world of science policy

#### Jan Hendrik Schön Loses His Ph.D.

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New Jersey

By Gretchen Vogel | 19 September 2011 3:45 pm | 0 Comments

**BERLIN**—A German court has ruled that it is legal to revoke the Ph.D. of disgraced physicist Jan Hendrik Schön. Schön was the center of a spectacular scandal in 2002, and the University of Konstanz revoked his Ph.D. in 2004. Although a university investigation turned up no evidence that Schön had committed misconduct while at the university, university officials asked Schön to return his doctoral certificate based on a state law that allows degrees to be revoked when the recipient proves "unworthy." Schön was found to have faked data in at least 17 papers while he was a researcher at Bell Laboratories in Murray Hill,

For further reading:  
Beasley Report

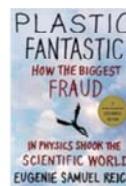
[publish.aps.org/reports/lucentrep.pdf](http://publish.aps.org/reports/lucentrep.pdf)

*Plastic Fantastic*, E.S. Reich  
(St. Martin's Griffin, 2010)

REPORT OF THE INVESTIGATION COMMITTEE  
ON THE POSSIBILITY OF SCIENTIFIC  
MISCONDUCT IN THE WORK OF HENDRIK  
SCHÖN AND COLLEAGUES

September 2002

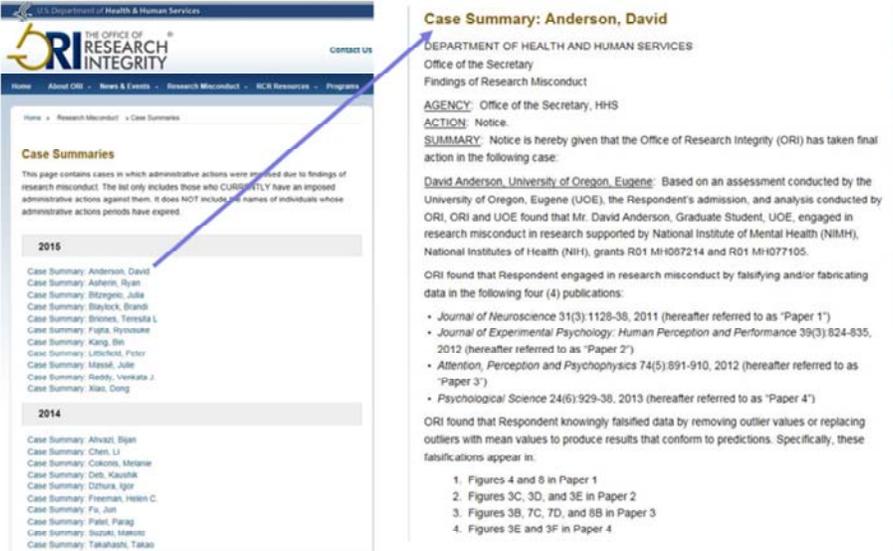
Property of Lucent Technologies



## Scientific misconduct is drawing increasing federal scrutiny

 NATIONAL SCIENCE FOUNDATION OFFICE OF INSPECTOR GENERAL OFFICE OF INVESTIGATIONS <b>CLOSEOUT MEMORANDUM</b>	
Case Number: A07100053	Page 1 of 1
<p>We referred allegations of fabrication and falsification of data to a university<sup>1</sup> following our inquiry into the allegations against a former post-doctoral researcher (post-doc)<sup>2</sup> and his mentor.<sup>3</sup> During the period of the alleged misconduct the mentor was a CAREER awardee<sup>4</sup> and provided acknowledgement to that award in some of the publications involved. The university conducted a full investigation in which it determined that both the post-doc and his mentor had committed research misconduct. The university found that the post-doc had hands-on responsibility for the misconduct. It also found that the mentor, once he had substantial reason to know of the misconduct, continued to use the suspect results to the point of committing research misconduct himself.</p> <p>We concurred with the university investigation and identified additional allegations based on the admissions of both the post-doc and mentor in their interviews, specifically the knowing falsification of the methodology reported in a published article. We recommended NSF make findings of research misconduct (report attached) and recommended debarments. Because of the ongoing risk to federal funds during the adjudication, NSF implemented our recommendation for government-wide suspensions for both pending a final determination.</p> <p>NSF made findings of research misconduct (attached) to which both the post-doc and the mentor appealed. Following the appeals, NSF modified its imposed actions in its final notice of debarment to both (attached).</p> <p>Accordingly, this case is <i>closed</i>.</p>	

## Scientific misconduct is drawing increasing federal scrutiny



**Case Summary: Anderson, David**

DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Office of the Secretary  
Findings of Research Misconduct

**AGENCY:** Office of the Secretary, HHS  
**ACTION:** Notice.  
**SUMMARY:** Notice is hereby given that the Office of Research Integrity (ORI) has taken final action in the following case:

**David Anderson, University of Oregon, Eugene:** Based on an assessment conducted by the University of Oregon, Eugene (UOE), the Respondent's admission, and analysis conducted by ORI, ORI and UOE found that Mr. David Anderson, Graduate Student, UOE, engaged in research misconduct in research supported by National Institute of Mental Health (NIMH), National Institutes of Health (NIH), grants R01 MH007214 and R01 MH077105.

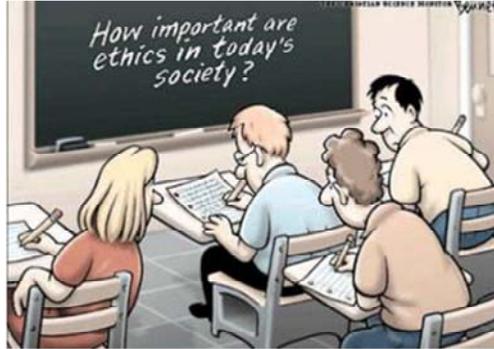
ORI found that Respondent engaged in research misconduct by falsifying and/or fabricating data in the following four (4) publications:

- *Journal of Neuroscience* 31(3):1128-38, 2011 (hereafter referred to as "Paper 1")
- *Journal of Experimental Psychology: Human Perception and Performance* 39(3):824-835, 2012 (hereafter referred to as "Paper 2")
- *Attention, Perception and Psychophysics* 74(5):891-910, 2012 (hereafter referred to as "Paper 3")
- *Psychological Science* 24(6):929-38, 2013 (hereafter referred to as "Paper 4")

ORI found that Respondent knowingly falsified data by removing outlier values or replacing outliers with mean values to produce results that conform to predictions. Specifically, these falsifications appear in:

1. Figures 4 and 6 in Paper 1
2. Figures 3C, 3D, and 3E in Paper 2
3. Figures 3B, 7C, 7D, and 8B in Paper 3
4. Figures 3E and 3F in Paper 4

**But, apart from what you learned in kindergarten,  
what ethics situations might you encounter  
early in your career?**



**Using and referencing others' scholarly work**  
**Data selection/rejection and treatment**  
**Intellectual property "ownership"; authorship**  
**Human relationships**

Human relationships—science is a social, collaborative endeavor. Friction and conflicts are inevitable.

## **Using and referencing others' work: Plagiarism is scientific misconduct**

**Submitting another's published or unpublished work, in whole, in part, or in paraphrase, as one's own without properly crediting the author by footnotes, citations, or bibliographical reference**

**Submitting material obtained from an individual or agency as one's own original work without reference to the person or agency as the source of the material**

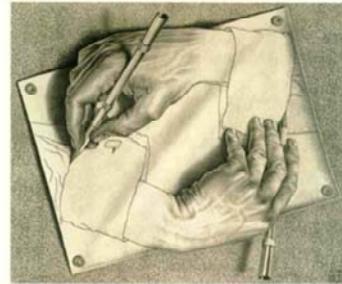
**Submitting material that has been produced through unacknowledged collaboration with others as one's own original work without written release from collaborators**

**It is also scientific career suicide**

Credit should always be given for others' work—in references, acknowledgments, and authorship.

**At first, it seems straightforward, but sometimes the lines are hard to draw**

**Using another author's ideas or words without proper documentation; representing someone else's creative work (ideas, words, images, etc.) as one's own, *whether intentional or not.***



M. C. Escher, *Drawing Hands*, 1948

**Now, let's look at a real example...**

## Plagiarism: Case Study\*

While classical melting in two-dimensional systems is reminiscent of the phase behavior observed as a function of pressure in this material, an important qualification should be made with respect to this comparison. In contrast to the examples described above, the melting process observed in  $1T\text{-TiSe}_2$  is quantum mechanical in nature, in that it is driven near  $T = 0$  K by pressure tuning the competing interactions in this system. To understand the nature of this competition, note first that the zero-pressure charge density wave (CDW) state in  $1T\text{-TiSe}_2$  is unconventional, as it arises from an indirect Jahn-Teller interaction that splits and lowers the unoccupied conduction band. As a result of the electron-hole interaction between the conduction and valence bands, the lowering of the split conduction band “repulses” and flattens the valence band, resulting in a lowering of the system’s energy, and the formation of a small gap CDW state.

From: C.S. Snow et al., Phys. Rev. Lett. 91, 136402 (2003)

\*S.L. Cooper, PHYS 496, 2008.

When to cite?

Is the fact readily available from numerous sources (textbooks) and generally known to the public? (no citation needed)

Is the idea or fact a result of unique individual research? (must cite)

If I change the words, do I still have to cite the source? **YES!**

### Original:

While classical melting in two-dimensional systems is reminiscent of the phase behavior observed as a function of pressure in this material, an important qualification should be made with respect to this comparison.

In contrast to the examples described above, the melting process observed in  $1T\text{-TiSe}_2$  is quantum mechanical in nature, in that it is driven near  $T = 0$  K by pressure tuning the competing interactions in this system.

To understand the nature of this competition, note first that the zero-pressure charge density wave (CDW) state in  $1T\text{-TiSe}_2$  is unconventional, as it arises from an indirect Jahn-Teller interaction that splits and lowers the unoccupied conduction band.

As a result of the electron-hole interaction between the conduction and valence bands, the lowering of the split conduction band “repulses” and flattens the valence band, resulting in a lowering of the system’s energy, and the formation of a small gap CDW state.

### Edited:

The phase behavior observed as a function of pressure in  $1T\text{-TiSe}_2$  is similar to classical melting in 2D materials.

However, in contrast to classical melting, the melting process seen in  $1T\text{-TiSe}_2$  is governed by quantum mechanics, as it the result of tuning the competing quantum mechanical interactions with pressure near  $T = 0$  K.

An examination of the unconventional charge density wave (CDW) in  $1T\text{-TiSe}_2$  state helps elucidate this competition—the CDW state in  $1T\text{-TiSe}_2$  is caused by an indirect Jahn–Teller interaction that lowers the unoccupied conduction band relative to the filled valence band.

Because there is a strong electron-hole interaction between the conduction and valence bands in this material, this lowering of the conduction band causes a “repulsion” and flattening of the valence band, which results in a lowering of the system’s energy and the formation of a small CDW small gap.

**Tips for avoiding plagiarism:**

**Study the original text until you *fully* understand its meaning**

**Set aside the original and write a summary of the text *in your own words***

**Check your version with the original to ensure that the meaning has been retained**

**Enclose any text or phrase that you have reproduced exactly in quotation marks**

**Cite the source!**

**Data selection:  
What if you have “bad” data?**



Data selection or treatment is okay,

- 1) as long as it is disclosed.
- 2) as long as the original data are kept permanently and made available to other researchers.

Ideally, decide **before** you do the experiment what your criteria are for rejecting data, so any data selection is results-neutral.

## Although data falsification or fabrication is clearly wrong, what about more-subtle data “selection”?

**Example:** In 1909, Millikan measured the charge  $e$  of the electron in his famous “oil drop” experiment ... there have been raging scholarly debates since then about his use of “selected” drops, given his claim that *all* drops were included in his published results

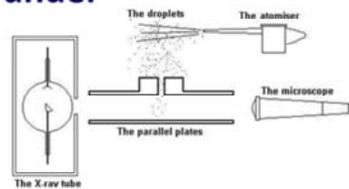
- Too bad there remains a kind of doubt hanging over it
- An important and highly scrutinized result (Nobel Prize),
- We won't debate that here, but you can read about it

<http://onlineethics.org/essays/research/cw2.html#under>



In science, it is generally accepted that certain data may be rejected, but under what conditions?

**Reality of the experimental method  
—things go wrong; equipment malfunctions, and people make mistakes**



## **Data may be excluded or manipulated but must be disclosed**

### **Use accepted statistical tests**

Chauvenet's criterion<sup>§</sup>: the outlier is more than  $t\sigma$  from the mean of  $N$  measurements

Kolmogorov-Smirnov tests, designed to compare runs against a standard data set in a result-independent manner

### **Decide before the experiment what your criteria are for accepting or excluding data**

"Result-unbiased" algorithm

### **More difficult ... after the experiment you discover biases based on something you monitored but you did not "pre-reject" data. Now what?**

Ideal, and gaining popularity, cast analysis in a result-blind manner, then make cuts without physics implication

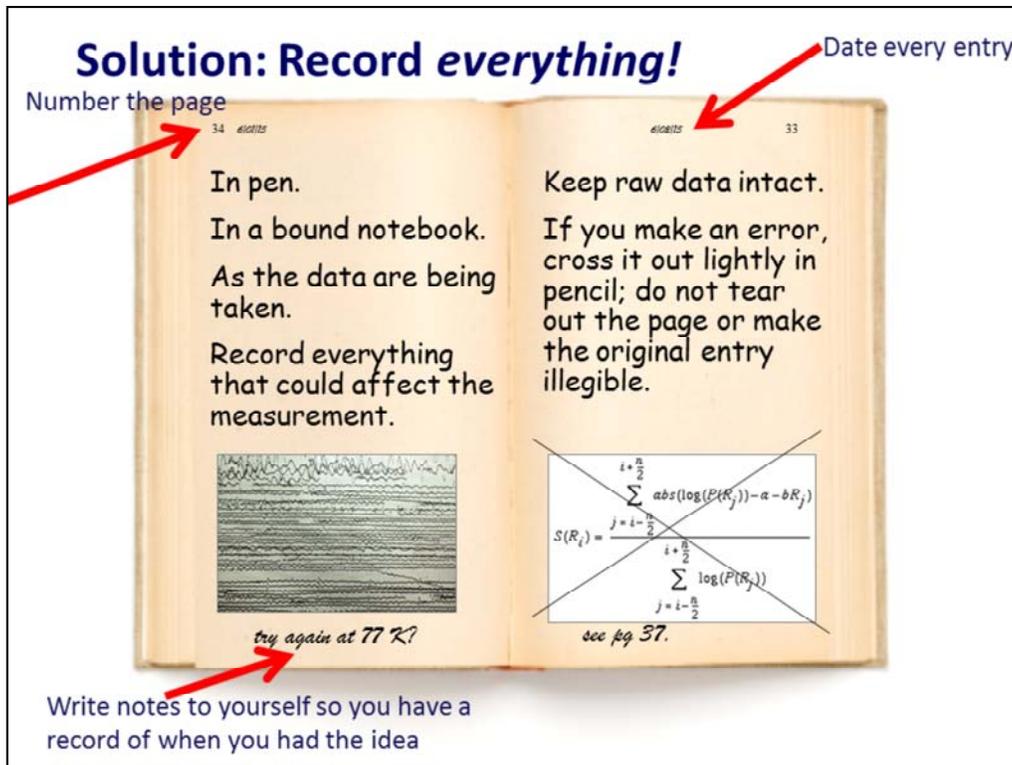
<sup>§</sup>J.R. Taylor, *An Introduction to Error Analysis* (Mill Valley CA, University Science Books, 1982).

## **Manipulation or enhancement of images is becoming is huge issue**

**From the Council of Science Editors\*:**

- 1. No specific feature within an image may be enhanced, obscured, moved, removed, or introduced.**
- 2. Adjustments of brightness, contrast, or color balance are acceptable if they are applied to the whole image and do not obscure, eliminate, or misrepresent any data present in the original.**
- 3. The grouping of images from different parts of the same image or from different images must be made explicit.**
- 4. If the author cannot produce the original data, acceptance of the manuscript should be revoked.**

\*<http://www.councilscienceeditors.org/resource-library/editorial-policies/white-paper-on-publication-ethics/3-4-digital-images-and-misconduct/>



Research results should be recorded and permanently maintained to allow for analysis and review.

Data should be immediately available to supervisors and collaborators.

After publication, original data records must be maintained completely and made available to other scientists.

Collaborations must have a mechanism to respond to questions about the joint work and share information with other scientists.

Falsification or fabrication of data is an egregious breach of ethical conduct.

Selective reporting of data with the intent to mislead or deceive is an egregious breach of ethical conduct.

## **Conflicts can arise over authorship**

**Authorship should be limited to those who contributed *meaningfully* to the concept, design, execution, or analysis of the work**

**Each person who contributed to the work should be offered authorship**

**Every co-author should have an opportunity to examine a manuscript prior to publication**

**Each author is obligated to promptly disclose errors and provide corrections for published work**

**Other contributors should be acknowledged**

**Credit should *always* be given for others' work**

**Coauthors and collaborators share responsibility for published work**

**Some coauthors are responsible for accuracy and verifiability of the *entire paper***

*Built the apparatus, recorded the data, analyzed the data, supervised junior researchers, wrote the paper*

**Coauthors who make specific, limited contributions may have only limited responsibility**

*Fabricated the thin films that others tested*

**All collaborations should have a process for reviewing and ensuring the accuracy and validity of reported results**

**Anyone unwilling or unable to accept appropriate responsibility for a paper should not be a coauthor**





Intellectual property: all intellectual property you create is “owned” by your employer, in this case, the University of Illinois.

Your notebooks and any other “work product” belong to the lab; you must leave them here at the end of your project. If you want to follow up on your research when you go to another institution, discuss it with your faculty supervisor now.

Don’t keep a separate, “personal” notebook; everything goes in the lab notebook. Your adviser will probably allow you to make copies to take with you, but ask permission.

## **Be aware of your other ethical responsibilities as a scientist**



**Don't claim expertise or credentials you don't have**

**Be proactive about avoiding conflicts of interest or commitment**

**Always disclose funding**

**Promote openness and collegiality**

**Treat colleagues and subordinates with respect**

Being an ethical scientist goes beyond “don’t cheat” and “don’t make things up.”

Represent yourself as an expert only in your field of competence and only to the extent that your formal qualifications, credentials, and relevant experience allow.

A variety of activities and relationships in science may lead to conflicts

- Financial support of research

- Adviser/student, collegial, and collaborative relationships

- Competitive relationships

Always disclose sources of funding

Science is a social, collaborative effort; it’s not all about YOU.

## **Every scientist has an ethical obligation to disclose scientific misconduct.**

That said, you also have an obligation to promote a supportive, collegial, cooperative environment. Don’t make an accusation until you have all the facts and have considered all options. Talk the situation over with someone you trust and who can give you objective advice.

**A simple analytical method can help you  
work through ethical questions**

**What are the issues and points of conflict?**

**What rules and regulations apply? What are  
your obligations as a scientist? As a citizen?**

**What questions do you need to ask? Of whom?**

**What resources are available to you (including  
your own values)?**

**What are your options?**

**Who will be affected by  
the outcome?**

**What are you going to *do*?**



## What are the issues and points of conflict?

- **data ownership and access**
- **plagiarism, cheating, or other academic misconduct**
- **authorship**
- **data selection or manipulation**
- **collegial interactions**
- **skepticism or objectivity**
- **conflict of interest**
- **social responsibility**



A variety of ethical issues and conflicts can arise in science.

We usually think of “conflicts of interest” as being financial, but in science they can also arise in reviewing, hiring and promoting, and other professional activities.

## What rules and regulations apply?

- intellectual property
- industrial espionage
- environmental protection
- use of human subjects
- hazardous or radioactive materials
- biohazards
- recombinant DNA
- occupational health and safety
- classified research
- “deemed export”



## What questions do you need to ask?

As a scientist, you must keep yourself informed of laws and regulations that govern the conduct of your research. “I didn’t know I couldn’t/shouldn’t do that” is not a viable defense.

Violations—even unintentional—can have profoundly adverse consequences:

1. Criminal penalties, including fines and jail
2. Civil penalties, including fines and awards of damages
3. Dismissal from an academic institution or an employer
4. Debarment from federal funding
5. Censure from professional colleagues

You must also understand funding agency policies and rules.

NSF: “Research Misconduct” (<http://www.nsf.gov/oig/resmisreg.pdf>)

Since 2010, every NSF-funded investigator must promise not only to be honest him- or herself, but must specifically state in all grant applications that students and postdocs working on a project will be trained in ethical and responsible conduct of research.

NIH: “NIH Policies and Procedures for Promoting Scientific Integrity” (November 2012); <http://ethics.od.nih.gov/>

## What are your obligations as a scientist?

- **honesty**
- **diligence**
- **objectivity**
- **openness**
- **collegiality**
- **mentoring younger scientists**
- **social responsibility**



Every profession has a code of conduct that it expects its practitioners to follow.

The APS has written guidelines for professional conduct (q.v. [http://www.aps.org/policy/statements/02\\_2.cfm](http://www.aps.org/policy/statements/02_2.cfm)) and specific statements on responsibilities of coauthors and collaborators, responsibilities of collaborations to archive and verify research records, responsibilities of authors to properly cite others' work, and responsibilities for the ethical treatment of subordinates.

Other professional societies have similar codes:

**American Chemical Society**

([http://portal.acs.org/portal/acs/corg/content?\\_nfpb=true&\\_pageLabel=PP\\_ARTICLEMAIN&node\\_id=1095&content\\_id=CNBP\\_023290&use\\_sec=true&sec\\_url\\_var=region1&\\_\\_uuid=31581f15-9ea8-4ee7-a7b9-14f84f9ca6fe](http://portal.acs.org/portal/acs/corg/content?_nfpb=true&_pageLabel=PP_ARTICLEMAIN&node_id=1095&content_id=CNBP_023290&use_sec=true&sec_url_var=region1&__uuid=31581f15-9ea8-4ee7-a7b9-14f84f9ca6fe))

**American Mathematical Society**

(<http://www.ams.org/about-us/governance/policy-statements/sec-ethics>)

**Association for Computing Machinery** (<http://www.acm.org/about/code-of-ethics>)

**Institute for Electrical and Electronic Engineers**

(<http://www.ieee.org/about/corporate/governance/p7-8.html>)

**Materials Research Society** (<http://www.mrs.org/publication-ethics/>)

Funding agencies also have specific ethical standards , and they investigate and prosecute offenders.

## What questions do you need to ask?

- What are the “facts” of the issue?
- What additional facts do I need to consider?  
Where could I get those answers?
- Who else will be affected by my decision?
- Who can advise me on the legalities of the situation?
- What is the worst thing that could happen?
- What happens if I do nothing?



Make sure you are fully informed of all the relevant circumstances before you take action or make a decision. Don't jump to conclusions.

## What resources are available to you?

- **trusted senior colleagues**
- **a senior administrator (dept head, dean)**
- **the institution's ethics office**
- **the institution's office of research**
- **the Graduate College**
- **a lawyer**
- **Office of the Inspector General  
at the funding agency**
- **online ethics resources**
- **your own values**



You do not have to face ethical issues alone; it is every scientist's obligation to help you if you ask for it. Seek help from people you trust who have more experience than you do.

## **What are your options?**

**Think through the consequences of each of  
your options**

**Consider the consequences of doing nothing**

**For you?**

**For everybody else who has a  
stake in the outcome?**



Think about as many possible outcomes as you can imagine. Analyze the problem the same way you would analyze any other problem. Ask yourself, “What is the worst thing that could happen?”

Write down your options. What are the benefits and consequences of each scenario?

If the option is “do nothing,” you should still consider the worst-case scenario of taking no action.

## Who will be affected by the outcome?

- you
- your supervisor
- others involved in the group
- the department
- a journal
- the university
- the funding agency
- the progress of science



It's not all about you. Think broadly about everybody that will be affected by your conduct.

## **What are you going to DO?**

**Don't just think about what you're going to *do*—  
practice what you're going to *say***

**Out loud**

**Write the words down**

**Practice on a friend you trust**



**Assign the following roles in your teams:**

**One person who will present the case and moderate  
class discussion after your case is presented**

**One person who will present the worst-case scenario**

**One person who will present the best-case scenario**



**In your case study, decide:**

**What are the issues and points of conflict?**

**Who will be affected by the outcome of your decision?**

**What are the consequences?**

**What are your obligations as a scientist?**



As you read the problem, think of the issues involved:

- data ownership and access
- plagiarism
- authorship
- data selection or manipulation
- collegial interactions
- skepticism
- conflict of interest
- social responsibility

Identify the interested parties; who has a stake in the outcome?

- the project 's principal investigator (PI)
- others involved in the group
- the university
- the funding agency
- the progress of science

For some ethical questions, there may not be a “right” answer. If you’re struggling, talk to someone whom you respect and trust.

What if the problem is with your supervisor? Talk to the department head, the dean, someone in student services, or someone in the campus research office. It is every scientist’s obligation to help you if you ask for it.