When writing up your results, you should make sure that the resulting publication will "represent with veracity, with accuracy, [and] with truthfulness the data you have obtained." -- Adil Shamoo.

Acquiring sound data

Responsible Conduct of Research

Office of Research Integrity (http://ori.dhhs.gov/) "fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results.

nine key topics

http://sciencecareers.sciencemag.org/gate1.inist.fr/career_magazine/previous_issues/articles/2010_11_19/caredit.a1000111 Page 1 of 5

http://sciencecareers.sciencemag.org/gate1.inist.fr
“People are adding things all the time when they come up with their internal list for their institutions,” says Daniel Vasgird, director of the Research Integrity and Compliance Office (http://oric.research.wvu.edu/) of West Virginia University in Morgantown. Some argue for adding financial responsibility and environmental health and safety, for example, he adds.

We are continuing to discuss these and other issues on Science Careers as part of our rolling feature (http://sciencecareers.scientificamerican.com/career_magazine/previous_issues/articles/2010_11_05/caredit.a1000108) on research integrity.

The pressure to cut corners can be high; in a 2002 national survey (http://www.nature.com/nature/journal/v435/n7043/full/435737a.html) of National Institutes of Health (NIH)–funded scientists, 23% admitted (http://caliber.ucpress.net/doi/pdf/10.1525/jer.2006.1.1.43) to “cutting corners in a hurry to complete a project.” But cutting corners can be risky, says Melissa Anderson, a research-ethics researcher at the University of Minnesota (http://www1.umn.edu/twincities/index.php), Twin Cities, and a co-author of that survey. Researchers who leave those last few essential tests until later “may forget that they skipped some steps, and then they present results as though they did them, or they may never have time to go back and make the changes.” Or, once the project is funded, they get caught up in the moment and “they don’t realize that their preliminary results weren’t on quite as solid ground as they thought they were.”

Record everything

One cornerstone of science is the necessity to keep thorough records so that you and others can go back and redo the work. Yet 27.5% of the respondents to Anderson’s 2002 survey admitted to inadequate record keeping.

Research Integrity and Compliance Office

Science

rolling feature

national survey

University of Minnesota

Record everything
Good record keeping starts with the lab notebook. So what constitutes a good lab notebook? It may be a traditional, bound-and-numbered paper book, or it may be a manipulation-proof online notation system. But it always provides a comprehensible, well-organized, accurate, complete, day-by-day account of what you do in the lab. Others “should be able to step in and understand everything that happened and pick up the work from that point on,” Anderson says. Early-career scientists need to understand the “appropriate standards of record keeping within their particular laboratory, within their institution, within their field,” Vasgird says. Also, make sure you store your notebooks securely but accessibly and fully back them up.

Use statistics properly

Another area where carelessness can have serious ethical consequences is in the use of statistics. Often, young scientists do not know enough about preparing their data for statistical analysis, or what test is appropriate under which conditions, Anderson says. “If you don’t have a good enough statistical grounding, you’d better get some help from someone who does.” Also, make sure you don’t lose track of what you’ve done and what you’re trying to achieve, she adds. Many young scientists produce hundreds of statistical runs “and they don’t know what variables they’ve changed, and they don’t know which run was supposed to do what, and they get all confused.”

Represent your data truthfully

Fifteen point three percent of respondents to Anderson’s survey admitted to “dropping observations or data points from analyses based on a gut feeling that they were inaccurate.” It’s wrong to “throw away information you don’t like,” Shamoo says. Sometimes it’s appropriate to discard outliers but only “if it is, let’s say, within 3 to 4 standard deviations of the mean. You say that, and you say what is the statistical reasoning” behind your decision, he continues. Selecting data for publication is a particularly tough problem; you always run the risk of leaving out meaningful data. “You have so much latitude in that selection,” Shamoo says, that it’s sometimes difficult to assess what is just sloppy or plain unethical. You need to apply your best and most honest judgment, being aware of the standards in your discipline and asking colleagues if necessary. “What would be unethical ... is if the data you didn’t include in the paper, for example, has direct bearing on the conclusion of the paper. What would be sloppy is, there are certain pieces of data” that are important “because it gives a different dimension to the outcome. It will not change the conclusion, [but it] was not published,” Shamoo adds. “The safest approach is to note parenthetically or in a footnote that further analyses were done and that they are available upon request or on a Web site. The point is to be sure that neither the work nor the findings are misrepresented by omission,” Anderson says.

Another gray area is how much you can alter images. “If you alter an image just to improve the clarity of what’s there, without misrepresenting it in any way, that is acceptable. If you alter the image because you think that some of the data points were off and you don’t have any good reason for thinking that, and you eliminate those data points, that’s falsification,” Anderson says. But “where you draw the line depends on the kind of work you’re doing, the way the data were collected, and the norms of the discipline.”

Write with fidelity

When writing up your results, you should make sure that the resulting publication will “represent with veracity, with accuracy, [and] with truthfulness the data you have obtained,” Shamoo says. That means providing a complete account of all the steps you took. Nowadays, many journals offer extra space in appendices or on the journal’s Web site; that lets you keep the core narrative clean and readable while documenting the work completely and publicly. “There is no excuse in this day and age not to have details of the experiments such that any graduate student anywhere in the world will be able to repeat it,” Shamoo says. If you really lack space, “you could say simply, ‘The details are not appropriate for this journal, please write to me’ or ‘Please go to my Web site.’ ” Also resist the temptation to over-interpret. Ask for feedback from your supervisor, who may have a broader view of the field and of what exactly can be claimed on the basis of the present findings, Anderson says. Feel free to make some educated guesses or speculations in your discussion, but clearly
Treat animals and human subjects with care

Points of reference

- National Science Foundation (http://www.nsf.gov/pubs/policydocs/pappguide/nsf10_1/aag_4.jsp#IVB)

Recognize your mistakes

Further reading

- Online Ethics Center for Engineering and Research (http://www.onlineethics.org/)
Responsible Conduct of Research (http://www.amazon.com/Responsible-Conduct-Research-Adil-Shamoo/dp/019536824X)

Online course (http://ori.dhhs.gov/education/products/columbia_wbt/index.html)

Teaching the Responsible Conduct of Research in Humans (http://ori.hhs.gov/education/products/ucla/default.htm)

Data Acquisition, Management, Sharing and Ownership (http://www.nationalpostdoc.org/publications/rcr/119-rcr-toolkit-data)

Communication and Difficult Conversations (http://www.nationalpostdoc.org/publications/rcr/113-rcr-toolkit-difficult-communication)

Guidelines for Responsible Data Management in Scientific Research (http://ori.hhs.gov/education/products/clinicaltools/data.pdf)

Do's and Don'ts for Keeping Lab Notebooks (http://techtransfer.tufts.edu/?pid=20&c=37)  Do's and Don'ts for e-Lab Notebooks (http://techtransfer.tufts.edu/?pid=21&c=38)

Plagiarism and self-plagiarism: What every author should know (http://www.biochemia-medica.com/content/plagiarism-and-self-plagiarism-what-every-author-should-know)


Stop Misbehaving (http://www.jci.org/articles/view/28824/version/1)  The Journal of Clinical Investigation

(top) John Haslam (http://www.flickr.com/people/foxypar4/)